APPENDIX 7

ECONOMIC ANALYSIS

YAZOO BACKWATER AREA, MISSISSIPPI
(REFORMULATION STUDY)

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ECONOMIC ANALYSIS

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YAZOO BACKWATER AREA, MISSISSIPPI
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APPENDIX 7
ECONOMIC ANALYSIS

SECTION 1 - INTRODUCTION

GENERAL

1. This appendix presents the economic analyses pertaining to the reformulation of water resources improvements contained in the Yazoo Area Pump Project Reformulation Report, Volume 1 (Revised), November 1982. These analyses address the economic feasibility of water resources improvements and aid in selecting a recommended water resources improvement project from the entire array of alternatives which initially included five pumping plant sizes and a Big Sunflower River levee alternative proposed along the Big Sunflower River. Benefit evaluations are based on current hydrologic analyses, land use and survey data, detailed cost data, extensive engineering and economic technical data, and other current factual data including Risk-based analyses incorporated into various structure and agricultural analyses. Factual data and computations describe the evaluation methodology utilized in determining annual benefits/costs for the improvements proposed. Evaluations of the initial array of alternatives are based on a 50-year growth period (economic development), an expected project economic useful life of 50 years, a Federal discount rate of 7-5/8 percent, and an estimated project completion date of 2005 for the pumping plant alternatives and 2006 for the Big Sunflower River levee alternative. (Data for the recommended plan utilize 1998 agricultural price levels, 1999 price levels for all other categories, a Federal discount rate of 6-5/8 percent, and a base year of 2006.)

2. Factual data consist of a description of the flood plain, discussion of properties affected by flooding, and discussion of benefits/impacts associated with the various plans of improvement considered and evaluated, including appropriate Risk-based analyses for specific parameters.

3. Initial assessments for this evaluation utilized costs for each plan of improvement based on August 1996 price levels. Average annual damages and benefits were expressed in 1996 price levels to compare to applicable average annual costs to determine economic feasibility of the various proposed plans of improvement.

4. Economic evaluations and analyses compared the without- (base hydrologic conditions) to with-project conditions in order to determine the National Economic Development (NED) plan for water resources improvement. With-project conditions in the analyses of the initial array of alternatives denote conditions with the installation of Plan 2 (14,000-cubic-foot-per-second (cfs) pumping plant) unless otherwise noted. The NED plan is the optimum plan economically, the plan that produces the greatest excess benefits over costs or net benefits. The without-project condition reflects conditions expected to prevail in the area in the absence of any additional water resources improvements and is equivalent to the "no-action" alternative.

5. The term "economic base study area" will be utilized in this report to denote Sharkey and Issaquena Counties, Mississippi, the area that appropriately reflects the economic problems, needs, conditions, and opportunities indicative of the entire Yazoo Backwater area. The terms "economic base study area" and "study area" will be utilized synonymously throughout this appendix, unless otherwise noted. The term "project area" is defined as the area directly affected by the construction of water resources improvement plans; also, the area encompassed by the 100-year frequency flood elevation delineation from existing/base or without-project conditions. Less than 10 percent of the project area is located outside the study area (Sharkey and Issaquena Counties).

6. "Urban" areas, defined by the Bureau of Census as communities with populations of 2,500 persons or more, do not exist in the project-impacted area. Therefore, population "cluster" areas in the project area will be referred to as "built-up" areas. For this study, the built-up areas include Cary, Eagle Lake, Holly Bluff, and Rolling Fork, and portions of Anguilla, Belzoni, Hollandale, Mayersville, and Valley Park, Mississippi, areas within the 100-year frequency flood

elevation delineation of the Yazoo Backwater area. For purposes of this study, all residences, commercial buildings, and other structures located within the built-up areas are identified and separated from residences, commercial buildings, and other structures located outside the built-up areas referred to as rural areas.

7. Detailed descriptions of alternative water resources improvement plans considered for this reformulation study are presented in the Main Report.

YAZOO BACKWATER AREA

LOCATION

8. The Yazoo Backwater area is located almost entirely within Sharkey and Issaquena Counties and partially within five additional counties in west-central Mississippi and southeastern Louisiana in the Yazoo River Basin (Humphreys, Warren, Washington, and Yazoo Counties, Mississippi, and Madison Parish, Louisiana). The area affected by implementation of the project (project area) covers a drainage area of approximately 1,000 square miles (see Plate 4-2). This area is bounded on the west by the east bank Mississippi River, on the north by State Highway 12, and on the east and south by bluff hills. The topography of the area is typified by flat, nearly level land, characteristic of the Mississippi River alluvial valley. The project area was once heavily forested with extensive bottom-land hardwoods, wetlands, swamps, and lakes. Local relief is provided by natural levees and alluvium from river meanders. Big Sunflower and Little Sunflower Rivers, Deer Creek, Steele Bayou, and Eagle Lake provide drainage to the project area. The Yazoo Backwater project area is defined as the area impacted by implementation/operation of the proposed projects/water resources improvements and consists roughly of the area encompassed by the delineation of a 100-year frequency flood event (see Plate 4-1). The evaluation of flood damages and benefits contained in this reformulation report is presented for the "project area" only, with four hydrologic-based reaches developed and utilized to address the flood problems in the Yazoo backwater area. Two water resources improvement projects within the backwater area

(Yazoo Area and Satartia Area Backwater levee projects) have been completed and will not impact the analyses of this report.

DESCRIPTION OF PROJECT AREA AND STUDY AREA

General

9. For purposes of this reformulation study, the project area is the area which would be directly impacted by implementation/operation of a water resources improvement project and is defined as the area subject to flooding by a 100-year frequency flood event. The project area is presented on Plate 4-34, which also presents the boundaries of the four hydrologic reaches established for evaluation of the proposed Yazoo Backwater area water resources improvements. Mississippi counties located within the Yazoo Backwater impacted area boundary include Issaquena and Sharkey Counties. In addition, portions of Humphreys, Warren, Washington, and Yazoo Counties, Mississippi, and a portion of Madison Parish, Louisiana, are located within the impacted area. These five counties comprise less than 10 percent of the total project area. This agriculturally oriented area is a part of the extremely rich deltaic region, containing extremely rich, highly fertile alluvial soils, and the cultivated area constitutes one of the more productive areas in the United States. Major agricultural crops produced in the area are cotton, soybeans, rice, grain, sorghum, and wheat. Catfish farming operations also contribute significantly to the total value of farm products sold within the project area.

10. Prior to water control improvements, the Yazoo Backwater area was subject to flooding from Mississippi River backwater which entered the area through a void between the end of the mainline Mississippi River levee and the adjacent hills.

11. Construction of the Will M. Whittington Auxiliary Channel divided the area west of the Yazoo River into two areas. The larger, more westerly of these areas is known as the Yazoo Area. The Yazoo Area encompasses a drainage area of 4,093 square miles of alluvial land, of

which approximately 1,406 square miles is protected from backwater flooding. Approximately 88 percent of the Yazoo Backwater area lies west of the Whittington channel and the lower reach of the Yazoo River.

12. The Yazoo Backwater area is protected from all but extreme backwater floods from the Mississippi River by a connecting levee that extends for approximately 28 miles between the lower limits of the Mississippi River east bank levee and the west bank of the Auxiliary Channel. The levee system, completed in 1978, includes two structures--one at Steele Bayou with a design capacity of 19,000 cfs and one at Little Sunflower River with a design capacity of 8,000 cfs. Additionally, a channel was constructed between the Sunflower River and Steele Bayou to connect the upper and lower ponding areas within the Yazoo Backwater area. The levee system is completed to an interim grade of 107.0 feet, National Geodetic Vertical Datum (NGVD), to be overtopped by the Mississippi River Project Design Flood allowing the entire backwater area to be flooded. The backwater levees will be raised to a grade 2 feet below the refined 1973 Mississippi River and Tributaries (MR&T) project flood flowline subsequent to the Mississippi River levee raising. Additionally, the Yazoo Backwater area is subject to flooding from interior ponding during periods of high Mississippi River stages.

Principal Streams/Tributaries/Lakes

13. Principal streams and water bodies in the project area are the Big Sunflower River, Little Sunflower River, Deer Creek, Steele Bayou, and Eagle Lake. In addition to these streams, the area contains a large number of oxbow lakes and wetland and backwater areas. The size of the oxbow lakes range from a few acres to more than 3,000 acres each.

Topography

14. The project area is characterized by the physiographic area of the alluvial Mississippi River Valley uplands. The Yazoo alluvium, or Delta area, is in the alluvial valley of the Mississippi River. These lands are gently sloping lowlands bordering the Mississippi River mainline levee. The topography is characterized by low, relatively flat, poorly drained flatlands with slopes of 0.3 to 0.9 foot per mile and belts of aligned hills and valleys. Elevations range from approximately 70 feet, NGVD, in southern low-lying areas to approximately 100 feet, NGVD, in the northern portion of the project area.

INTERIOR DRAINAGE

15. The Yazoo Area is drained by the Big Sunflower and Little Sunflower Rivers, Deer Creek, Steele Bayou, and Eagle Lake. Interior drainage from these systems is evacuated by structures at the Little Sunflower River and at Steele Bayou. Connecting channels are constructed from the Big Sunflower River to the Little Sunflower River, connecting with Steele Bayou, intercepting Deer Creek. Other features of the area include sloughs, oxbows, swales, backswamps, meander scars, and natural ponds abandoned by the ancient Ohio and Mississippi Rivers and by smaller rivers.

CLIMATE

16. The climate of the project area is primarily humid, subtropical with abundant precipitation generally influenced by the Gulf of Mexico to the south and the continental landmass to the north. Summers are long, hot, and humid--the area is almost totally dominated by the westward extension of the Bermuda high, a subtropical, semipermanent anticyclone. Generous supplies of moisture and thermal instability, associated with the prevailing flow, combine to produce frequent afternoon and evening thunderstorms. Temperatures of 90 degrees F or greater are expected an average of 66 days annually with a normal annual temperature of 64 degrees F and an average of

33 days when the temperature is expected to be colder than 32 degrees F. Observed temperature extremes in the project area range from -16 to 115 degrees F. The normal annual precipitation is 52 inches, with rainfall amounts heaviest during the months of December to April, with minimum rainfall occurring generally during the months of September and October. Precipitation in the project area maximizes in March with an average of approximately 5.7 inches and minimizes in October when the average is approximately 2.5 inches. Severe rainfall, producing locally intense runoff and flooding, can occur at any time of the year. The average length of the frost-free growing season is approximately 230 days--over 7 months. An annual snowfall event occurs in the project area on the average, with average accumulations of approximately 2 inches.

GENERAL

17. Highly productive agricultural lands, wildlife, forested areas, lakes, streams, wetland areas, and minerals are the project area's most valuable natural resources. Agricultural lands, accounting for greater than three-fourths of the total land use, are major resources. The project area's economy was based and currently depends upon its agricultural industry. Major crops include cotton, soybeans, and rice. Other economically valuable crops include corn, wheat, oats, and grain sorghum. Catfish production is a significant element of the area's total farm economy. Streams, lakes, and wetland areas provide habitat for wildlife and are used by area residents in outdoor sports activities. Wetlands are scattered throughout the project area; however, the most significant areas are located in the southern part of the project area. Forest land consists primarily of the oak-hickory and oak-gum-cypress types. Bottom-land hardwood areas support excellent populations of deer, turkey, small game, and nongame species. In addition to the tributary systems, numerous lakes provide adequate fishing opportunities for area residents. Some of the larger lakes in the project area are Eagle, Cypress, Washington, Five-Mile, and George Lakes. Mineral resources include clay, sand, gravel, and stone. Also, undeveloped lignite deposits occur in the southern portion of the project area.

AREA SOILS

18. The alluvial soils of the project area are very fertile, produce excellent agricultural crops, and support vigorous growths of hardwood forests comprised of numerous species adaptable to varying and complex soil and moisture conditions. Better drained natural levees and ridges with loamy or sandy clay soils support a water oak-sweetgum timber type containing several other deciduous species. Extensive flats of slightly lower elevation are occupied by hackberry, elm, ash, and Nuttall oak. Lower lying areas support an overcup oak-water hickory type. Wet lake margins, sloughs, and swamps support cypress, tupelo gum, willow, and water elm.

AREA RIVERS AND STREAMS

19. Principal streams within the project area include the Little Sunflower and Big Sunflower Rivers, Steele Bayou, Deer Creek, and the connecting channels. The Little Sunflower River begins in the northern part of the project area and meanders south to a junction with the Yazoo River. The Big Sunflower River flows through the project area from northeast to south, eventually intercepting the Yazoo River; Steele Bayou and Deer Creek flow through the project area from north to south. Two connecting channels are constructed within the project area. One of these channels connects the Big Sunflower and Little Sunflower Rivers; the other parallels the Yazoo River levee from the structure on the Little Sunflower River to the structure on Steele Bayou.

20. In addition to the streams and rivers, the Yazoo Backwater area contains a large oxbow lake (Eagle Lake) and numerous wetland and backwater areas. Eagle Lake was formed more than 100 years ago by a natural cutoff of the Mississippi River and has a minimum surface area of approximately 3,000 acres. The old river channel occupied by the lake continues to be the boundary between the States of Mississippi and Louisiana. Historically, these lakes and wetland

areas have provided excellent fishing, waterfowl hunting, and other recreational opportunities. Collins Creek is the principal drainage artery canal in the Satartia area. This canal drains into the Yazoo River upstream of the proposed pumping plant location.

FOREST

21. The forests of the project area are primarily bottom-land hardwoods and vary considerably in composition and density. Conditions of the forested areas depend primarily on ownership, past and present silvicultural practices, and local site quality. Sweetgum, for example, is usually found in association with water oaks. The older soil formations or terraces are characterized by cherrybark oak, swamp chestnut oak, hickory, white oak, blackgum, and winged elm. Cypress is the only softwood of importance in the bottom lands. Stands of tupelo gum and cypress occur in the swamps and on other fertile, but very heavy, "buckshot" soils of low, wet flats and deep sloughs. Areas between these low flats and slightly higher elevations consist of green ash, Nuttall oak, boxelder, hackberry, overcup oak, bitter pecan, and various intergradations of species that occur above and below these elevations.

22. Wooded swamps provide valuable habitat for furbearers, resident and wintering waterfowl, songbirds, shorebirds, wading birds, and various other wildlife species including deer, turkey, and swamp rabbit. These swamps are highly desirable nesting and roosting habitat for wood ducks. Important fur-bearing animals using wooded swamps include raccoon, mink, nutria, river otter, muskrat, and beaver.

23. Seasonally flooded basins and flats are the predominant wetland type located throughout the project area. The vegetation in this type wetland is influenced by the soils and the duration, frequency, depth, and season of flooding. The flooded flats within the area attract high concentrations of mallards and wood ducks and provide food and cover for a number of game and nongame animals and furbearers.

24. Future land use in the project area is expected to parallel present conditions of intensive agricultural development. Land use in the project area will depend to a large degree on future market demands for agricultural production and incentives for reforestation.

25. Between 1967 and 1973, forest areas decreased from 56 to 55 percent of the total land area within the State of Mississippi. From 1957 to 1967, clearing decreased the remaining commercial forest in the Delta by 22 percent. From 1967 to 1973, clearing decreased the remaining Delta forest by 14 percent and was planted primarily in soybeans and cotton. The Delta unit, which is associated primarily with the alluvial plain of the Mississippi River, contains some of the state's most productive land. Since introduction of the Conservation Reserve Program (CRP) and the Wetlands Reserve Program (WRP), several thousand acres of frequently flooded or highly erodable land have been reforested.

FISH AND WILDLIFE

26. The current farming practices of straight-row cropping, cultivation to the edges of streams and lakes, large-field monoculture, and other "clean farming" practices allow limited habitat for wildlife. In addition, the widespread use of agricultural chemicals, coupled with heavy suspended sediment loads washed into area streams and lakes from agricultural areas, has contributed greatly to the loss and degradation of aquatic and terrestrial wildlife habitat in the Delta.

27. Frequent winter and early spring flooding of woodlands and low-lying farmlands provides habitat for wintering waterfowl. The amount of waterfowl habitat is expected to increase with the reforestation of agricultural lands within the project area.

WILDLIFE RESOURCES

28. Bottom-land hardwood areas presently cover approximately 204,000 acres in the pumping plant project area; wooded swamps cover approximately 30,000 acres. Most of these remaining

forested areas have poor to fair fish values, but are rated high in wildlife values. These woodland areas provide essential and highly productive habitat for white-tailed deer, wild turkey, squirrels, raccoons, opossums, mink, otter, cottontail and swamp rabbits, nesting and migratory waterfowl, herons, egrets, hawks, owls, and many species of nesting and wintering songbirds. Various species of turtles, snakes, and amphibians and the American alligator are native to the area.

29. Two endangered species were identified by FWS as potentially occurring in the project area. These include the pondberry plant (Lindera melissifolia) and the Louisiana black bear (Ursus americanus luteolus). The pondberry is a low deciduous plant growing in bottom-land hardwood communities. It usually grows in close proximity to water and is more dependent upon local hydrology than overbank flowing. The Louisiana black bear is a generally recognized subspecies of the American black bear. It historically occurred in bottom-land hardwood forests from eastern Texas through all of Louisiana to southern Mississippi. The Louisiana black bear became a threatened species primarily because the habitat of the bear has suffered extensive modification with suitable habitat having been reduced by more than 80 percent as of 1980. The remaining habitat has been reduced in quality by fragmentation due to intrusion of man and his structures.

FISHERY RESOURCES

30. Fifty-seven species of fish were identified as being residents of the study area, including flathead catfish, freshwater drum, gizzard shad, common carp, bigmouth buffalo, white crappie, gar, bowfin and bull heads, and sunfishes. Most of the species represent those tolerant of degraded environments. High turbidity and uniformly shallow water were found to be significant factors prohibiting species diversity. Spawning habitat was the highest in the fringe flood plain around the Steele Bayou structure and in the oxbow lakes contiguous with the Big Sunflower River or one of its tributaries. Overall, permanent water bodies on the flood plain provide higher habitat value to rearing fishes than cleared lands. Thermal stratification is pronounced during late

spring and summer, particularly in the flood plain behind the Steele Bayou structure. Low dissolved oxygen along with high water temperatures contributes to physiological stress and may result in substantial mortality of fishes.

RECREATION

31. Major recreational activities in the project area are hunting and fishing, with associated use of lakes and streams. Limited public use facilities exist for camping and boating. The clearing of vast acreages of woodlands and poor water quality is significantly reducing the environmental diversity necessary for outdoor recreational activity.

32. The Delta National Forest as well as some State Wildlife Management Areas and National Wildlife Refuges are located in the project area and provide public use areas for hunting, fishing, and wildlife-oriented recreation. Current recreation needs include improved public access to available areas and development of additional recreational areas with facilities for parking, access, etc.

ECONOMY

GENERAL

33. The economy of the project area is based on agricultural enterprises including cotton, soybeans, rice, wheat, cattle, catfish farming, forestry, agribusiness enterprises, insurance and other industries, and trade. The market value of agricultural products sold in the study area was estimated to be $87.5 million in 1992, with commodity crops accounting for 88.4 percent of this value.

34. The total value of forestry resources in the study area is estimated to be $63 million, based on data from the 1992 Census of Agriculture. These timber resources provide commercial

products for wood yards, pulpmills, and sawmills within the project area. These industries represent a significant input to the economy of the project area and adjacent areas. Minor enterprises include commercial fishing, trapping, and the sale of hunting and fishing supplies.

POPULATION

35. Based on U.S. Department of Commerce data, the population of the study area was an estimated 10,500 persons in 1996. Principal population centers in or adjacent to the project area are Anguilla, Belzoni, Cary, Eagle Lake, Hollandale, Holly Bluff, Mayersville, Rolling Fork, and Valley Park, Mississippi. The remaining population is sparse and is centered around older farming areas and communities. Vicksburg, Mississippi (1990 population 20,908), and Greenville, Mississippi (population 45,226), are located to the south and northwest of the project area, respectively.

LAND USE

36. The Yazoo Backwater area flooded by the 100-year frequency flood event includes approximately 630,000 acres of land. The area consists of an estimated 57 percent (360,000 acres) in cleared row crops, livestock production, and miscellaneous and idle uses, with approximately 37 percent (234,000 acres) in woodlands and 6 percent (35,000 acres) in water. Approximately 83,000 acres of the woodlands in the project area are considered dedicated (800 additional acres are dedicated in the completed levee areas) and are not owned by the private sector. Included in the woodlands are 22,000 acres of wooded swamps (cypress-tupelo gum) and approximately 9,000 acres of wooded wetlands (overcup oak-bitter pecan). These acreages are scattered throughout the project area in small tracts. In addition to land area, the project area contains approximately 3,800 acres of streams and 31,000 acres in water bodies such as lakes and oxbows.

37. The major portion of the project area is located within Issaquena and Sharkey Counties. Land use development patterns within these two counties are representative of development patterns throughout the project area. Issaquena and Sharkey Counties comprise 850 square miles. Of this area, 471.7 square miles (55.5 percent) are in agricultural uses while 289.4 square miles (34.0 percent) are in forests. Water bodies comprise 58.6 square miles (6.9 percent), and other uses, including marshes and swamps, comprise 19.7 square miles (2.3 percent). Approximately 5 square miles (0.6 percent) are in residential use while 3.3 square miles (0.4 percent) are used for transportation and utilities. Commercial, industrial, institutional, and recreational uses each comprise less than 0.1 percent of the total project land area.

38. Landownership in the project area varies in tract size, with approximately 1,600 holdings; large corporate holdings and moderate to large farm units and timber tracts predominate. Publicly owned lands include 16th Section school lands, the Delta National Forest, Panther Swamp National Wildlife Refuge (NWR), the Yazoo NWR, Lake George Project, Twin Oaks Wildlife Management Area, and Mahannah Wildlife Management Area.

39. An analysis of future conditions indicates that land requirements for residential, commercial, and recreational uses and roads, railroads, etc., will remain essentially unchanged. Current and expected future markets for agricultural commodities require larger scale agricultural enterprises and are expected to result in a continuation of present land usage within the project area.

40. Woodlands within the Delta National Forest, Panther Swamp NWR, and the Yazoo NWR comprise approximately 81,000 acres of dedicated forestry areas. (Delta Wildlife and Forestry, Inc., a privately owned tract, is also considered a dedicated forestry area.)

SECTION 2 - PROBLEMS AND NEEDS

GENERAL

41. When the Little Sunflower River and Steele Bayou structures are closed due to high stages on the Mississippi River, flooding from ponding of interior drainage is the principal problem in the project area. Major problems that have resulted from frequent flooding include flood damage to agricultural crops, noncrop items, rural residential property, and public roads and bridges. Major floods have also caused undue hardships and economic losses to residents of the area, due to flooding of homes and disruption of sanitation facilities and lines of communication.

PROBLEMS

42. Major problems which have resulted from frequent flooding include flood damage to agricultural crops; noncrop items; built-up property/structures; and public roads and bridges; and a restriction on the part of farm operators to apply improved production inputs and techniques. Backwater flooding occurs in the southern part of the area when high river stages cause ponding.

FLOODING

43. Flooding is the principal problem in the project area. Major problems that have resulted from frequent flooding include flood damage to agricultural crops, noncrop items, rural residential property, and public roads and bridges, and a reluctance on the part of farm operators to apply improved production inputs and techniques. Three important factors which affect flood losses to agricultural lands are time of year, duration, and frequency of flooding. Frequent or intermittent floods can occur any time of year; however, flood records indicate that the majority of floods

occur during the land preparation and spring planting months (January through June). Average flood duration is in excess of 30 days, and the average frequency of occurrence is as often as 1.5 times annually.

44. The alluvial lands of the project area have always been subject to flooding by the Mississippi River. From 1897 through 1937, massive floods inundated the region regularly. Then, for a 35-year period, less severe flooding occurred, causing many to dismiss massive floods as things of the past. However, in 1973, a severe flood devastated the area again. Other destructive floods followed in rapid succession in 1974, 1975, and 1979. Hundreds of persons were forced from their homes, crops and buildings were damaged or lost, and wildlife was destroyed.

45. Following 35 years of primarily moderate flooding, severe flooding recurred in the 1970's decade. In the Yazoo Area, flooding occurred each year in the 1970 decade. Smaller floods in 1970, 1971, 1972, and 1978 were accompanied by massive floods in 1973, 1974, 1975, and 1979. Comparatively, much smaller floods occurred in 1976 and 1977.

46. The most severe flood of the 1970 decade (1973) created a body of water 60 miles long (almost as large as the Great Salt Lake), with financial losses in excess of $65 million and with personal trauma immeasurable in dollars. The flooding lasted almost 9 months.

47. For existing conditions, interior ponding inundates low-lying lands in the project area damaging manmade resources and agricultural crops. In addition to agricultural crops, farm improvements, and public roads and bridges, 1,555 urban structures (including residential, commercial, industrial, public, professional, warehouse, recreational, and semipublic properties) are subject to flooding in the pumping plant project area. Current engineering and economic studies indicate that 231,457 cleared acres are flooded on an average annual basis. Present average annual damages to agricultural crops and manmade resources are estimated to be $17.5 million for the project area.

48. The continuing decline of fish and wildlife habitat constitutes a problem of local, state, and national significance. Since 1966, when soybeans became the most valuable agricultural cash crop in the nation, productive bottom-land forests have been reduced on the flood plain of the lower Mississippi River. These bottom-land forests provide forest products and quality habitat for a variety of wildlife. Of the 234,000 acres of woodland existing in the project area, 90,000 acres are within managed areas. The quality of water bodies has declined due to increased soil and agricultural chemical runoff.

49. There is a definite need to provide flood protection and thereby reduce the financial and social risks involved in rural development. There is also a need to maintain quality habitat to support fish and wildlife resources.

CHARACTERISTICS OF FLOODING

50. Flooding characteristics consist of frequency, duration, time of year, and depth of flooding as well as velocity, sediment load, etc. Floods occur primarily in the first and second quarters of the year (January through June), but can occur any time. On the average, flood duration ranges from an 8-day duration to an 89-day duration. The frequency of occurrence of flooding varies from 0.4 times annually to 8.6 times annually. Flood events are frequent and relatively large as reflected by the annual frequency flood event (with a probability of occurrence of 1.0). This event floods 185,000 cleared and wooded acres in the project area. A 3-year frequency flood event would inundate 353,000 total acres.

AREA SUBJECT TO FLOODING FOR BASE (WITHOUT-PROJECT) CONDITIONS FROM THE 100-YEAR FREQUENCY FLOOD EVENT

51. The total area subject to flooding by the 100-year frequency flood event is 630,000 acres. Fifty-seven percent of the total area inundated consists of cleared lands. The remainder is in woodlands (37 percent) and in water (6 percent) with the rest in idle uses. During the 1943-1993 period, the maximum number of acres flooded occurred in the spring of 1973. No "urban" areas exist in the project-impacted area as urban areas are defined by the Bureau of the Census; i.e., a town with a population of 2,500 persons or greater. Therefore, populated areas within this project/study area will be referred to as "built-up" areas. For this study, the built-up areas that flood include Cary, Eagle Lake, Holly Bluff, and Rolling Fork, and portions of other built-up areas that flood including Anguilla, Belzoni, Hollandale, Mayersville, and Valley Park, Mississippi. For purposes of this study, all residences, commercial buildings, and other structures located within the built-up areas are identified and separated from residences, commercial buildings, and other structures located outside the built-up areas referred to as rural areas.

52. Approximately 499,000 acres are inundated on an average annual basis in the Yazoo Backwater area for base (without-project) conditions. Forty-six percent of the average annual acres flooded (231,450 acres) are cleared cropland acres. Eighty-four percent of the average annual cleared acres flooded are located at or below the 2-year frequency flood event.

53. The following plates illustrate, for base (without-project) and with-project conditions, the 100-year frequency flood (Plate 4-29), the 10-year frequency flood (Plate 4-28), and the 1-year frequency flood (Plate 4-26).

FLOOD SEASONS, DURATION, AND FREQUENCY OF OCCURRENCE

54. Three important factors which affect flood losses to agricultural lands are time of year, duration, and frequency of flooding. Frequent or intermittent flooding can occur any time of year. However, flood records indicate that the majority of the floods occur during the spring planting and summer growing months (January through June). Average flood duration varies from an 8-day duration in Reach 1 to an 89-day duration also in Reach 1. Frequency of occurrence varies from 0.4 times annually in Reach 1 to 8.6 times annually also in Reach 1. The historical flood record covered a 55-year period (1943-1997).

ECONOMIC DEVELOPMENT

55. Economic and demographic data are included for the Yazoo Backwater study area to provide a description of the economic structure of the area. The study area includes the political boundary of Sharkey and Issaquena Counties, Mississippi. These counties are located completely within or primarily within the Yazoo backwater hydrological boundary and are considered representative of the project area. Small portions of other counties, which are within the outer limits of the hydrological boundary, were not included as part of the study area since their inclusion would result in a misrepresentative economic analysis. The study area is presented on Plate 4-1. Counties excluded from the analyses are Yazoo, Humphreys, Washington, and Warren Counties, Mississippi, and Madison Parish, Louisiana. Since the 1930's, the base area has suffered population losses, primarily from rural areas. The population has become more urbanized and, in recent years, the study area has experienced significant industrial growth. However, agriculture is still the most important sector of the total economy. Growth in industrial activity and advanced technology in the agricultural industry have been the major factors contributing to increased personal income of area residents. Economic and demographic data are presented to furnish an analysis of the area's past, present, and projected future economic development. Projections are based on extensions of past relationships--establishing order or pattern that can be recognized and

translated into the future. Projections should be used as an indicator of the direction and relative magnitude of economic activity that may be expected to prevail in the study area.

EXISTING FLOOD PLAIN DEVELOPMENT

56. Surveys were conducted to identify and categorize the existing land use and development in the flood plain. Land use data and other information were obtained from interviews with applicable county agricultural workers; city and county officials; city and county engineers; U.S. Department of Agriculture scientists at the Delta Branch Experiment Station at Stoneville, Mississippi; scientists at the Mississippi Agricultural and Forestry Experiment Station, MSU; the Farm Service Agency (FSA); and Natural Resources Conservation Service (NRCS) state office personnel at Jackson, Mississippi. Other sources of required information on overall land use included data from the Economic Impact Forecast System, Bureau of the Census, Bureau of Labor Statistics, Bureau of Economic Analysis, County and City Data Book, Mississippi Statistical Abstract, U.S. Census of Agriculture, and MSU (Agricultural Economics Department).

57. Historically, favorable agricultural characteristics have been significant factors in the development of land use patterns in the Yazoo Backwater area. Cleared land accounts for approximately 64 percent of the total 553,234 acres in the study area, while the remainder is comprised of forest lands, built-up areas, and other related uses.

58. Agricultural lands comprised the majority of the total land use. Other nonbuilt-up area uses include forest lands, water bodies, wetlands, and barren or other lands. For purposes of the economic analysis of water resources improvements in the project area, built-up/rural development has been categorized into seven specific types of structures: residential, commercial, professional, industrial, public, semipublic, recreation, and warehouses. Other built-up area land use properties include rights-of-way, highways, roads, bridges, railroads, airports, pipelines, utilities, communications, park lands, other appurtenances, and open space.

MOST PROBABLE FUTURE LAND USE

59. Future land use in the Yazoo Backwater area flood plain without or with implementation of water resources improvements is expected to parallel that of current use. Existing trends toward increased reliance on manufacturing and the lesser importance of agriculture are expected to continue.

60. Should development in the built-up areas increase, these areas will likely continue to expand and change, resulting in conversion of agricultural lands to residential, commercial, public, and industrial uses. Industrial, residential, and other built-up growth could occur in these areas as a result of reduced flood risk.

61. Land use patterns similar to those that currently exist in the Yazoo Backwater area are anticipated to continue in the future. Agricultural production is expected to continue as the primary factor in the local economy, although industrial diversification continues within the project area. Built-up areas should expand at a slight rate in the present areas bordering the existing built-up areas. Any level of flood protection would reduce the financial risks involved in rural and/or built-up area development. Only minor changes are expected in future rural land use within the project area. There has been some reforestation of cropland over the past 5 years. Additional land may be reforested in the future; however, the uncertainty in the funding for future reforestation makes projections of this trend difficult. Current agricultural use is expected to continue relatively unchanged. Reduction in the risk of flooding will create opportunities for farmers to maximize production potential with some shifts in usage such as conversion of soybean land to cotton, rice, catfish ponds, etc. Due to the similarity of land use within the 20-, 50-, and 100-year frequencies delineation and since the area is primarily an agricultural area, it is impractical to present land use data for each delineation. Land use presented above would be applicable to each flood frequency delineation.

SECTION 3 - AUTHORITY AND PRIOR REPORTS

PROJECT AUTHORITY

62. Flood protection for the entire Yazoo Backwater area was authorized by Section 3 of the Flood Control Act of 18 August 1941, which states in part:

> "(b) The project for flood control of the Yazoo River shall be as authorized by the Flood Control Act approved June 15, 1936, as amended, by Section 2 of the Act approved June 28, 1938, except that the Chief of Engineers may, in his discretion, from time to time, substitute therefor combinations of reservoirs, levees, and channel improvements; and except that the extension of the authorized project and improvements contemplated in Plan C of the report of March 7, 1941, of the Mississippi River Commission is authorized."

AUTHORIZED PROJECT

63. The 7 March 1941 report by the Mississippi River Commission (CEMRC), which is printed in House Document 359, 77th Congress, was prepared in response to resolutions by the Committee on Flood Control, House of Representatives, and the Committee on Commerce of the Senate, dated 2 August 1939 and 12 March 1940, respectively. The plan recommended in this report included a levee along the west bank of the Yazoo River from the Mississippi River levee to Yazoo City, a drainage structure at Little Sunflower River, and combination of structures and pumping plants at Big Sunflower, Deer Creek, and Steele Bayou with a total pumping capacity of 14,000 cfs.

64. The capacities of the three pumping stations (Sunflower River, Deer Creek, and Steele Bayou) were to be 11,000; 700; and 2,300 cfs, respectively. By closing the structures and operating the pumps when the Yazoo River reached elevation 80 feet, NGVD, the pumping capacity of 14,000 cfs would prevent the ponding elevation from rising above elevation 90 feet, NGVD, more often than once in 5 years on the average.

PROJECT MODIFICATIONS

65. Although the backwater levees and pumps were authorized, no construction was undertaken until the 1960's. As a result of the review of the MR&T project completed on 6 April 1962 and published in House Document 308, 88th Congress, 2d Session, the Chief of Engineers modified the authorized plan to provide for a gravity drainage system including a connecting channel between the Sunflower River and Steele Bayou structures. The Chief stated that this modification did not affect the authorization of pumping plants--authorization he considered to be sufficiently broad to permit selection of locations and capacities of pumping plants or a combination of gravity and pumped drainage, as future developments dictate.

PRIOR REPORTS

66. Review Report on the Project for Flood Control of the Mississippi River in Its Alluvial Valley, dated 7 March 1941. This report proposed three plans for protection against backwater flooding. Each plan included levees, with all drainage to be pumped. The Flood Control Act of 18 August 1941 authorized the project. World War II occurred during the time work would have typically been accomplished; consequently, no construction was begun.

67. Consolidated Report on the Yazoo Basin Backwater Protection Plan, dated 10 November 1947. This report recommended that the Yazoo Backwater plan be modified to include general provisions for the development of fish and wildlife resources in the area. This report was deferred by letter of the President of CEMRC, 8 July 1949.

68. Comprehensive Review of the Mississippi River and Its Tributaries, dated 6 April 1962. As a result of the review of the MR&T Project completed on 6 April 1962, published in House Document 308, 88th Congress, 2d Session, the Chief of Engineers modified the authorized plan to include a connecting channel between the Sunflower River and Steele Bayou, with all interior drainage evacuated through the Little Sunflower and Steele Bayou structures. The Chief of Engineers' report in House Document 308, in part, states as follows:

> . . . I believe that, at some future time, protection of some areas in the Yazoo Backwater by pumping may be warranted. Since the new plan developed by the Mississippi River Commission is proposed for construction under existing project authorization, selection of this plan does not affect those authorizations, which I consider sufficiently broad to permit selection of location and capacities of pumping plants, or a combination of gravity and pumped drainage, as future developments dictate. The selection would be made after study, within present authorization to determine economic justification, and with such modification as in the discretion of the Chief of Engineers may be advisable.

SUBSEQUENT STUDIES

69. Construction work on the backwater levee system progressed slowly during the late 1960's and early 1970's. After the flood of 1973, work progressed much more rapidly, and the Yazoo Area levee system was closed in December 1977. Shortly after the 1973 flood, local interests requested that the Yazoo Area be reviewed to determine if the pumps would be economically justified. Authority to initiate studies was provided by CEMRC in November 1973. These studies resulted in the previously recommended plan of 17,500-cfs pumping capacity.

EXISTING BACKWATER LEVEES

Yazoo Area

70. Flood control works completed in the Yazoo Area of the Yazoo Backwater area include a levee system approximately 27.8 miles in length, extending from the end of the east bank Mississippi River levee, generally along the west bank of the Yazoo River to a connection with the west levee of the Will M. Whittington Auxiliary Channel. This levee system includes two structures (one at Steele Bayou with a design capacity at 19,000 cfs and one at Little Sunflower River with a design capacity of 8,000 cfs) and a 24.4-mile connecting channel between the Sunflower River and Steele Bayou to connect the upper and lower ponding areas within the Yazoo Area. The levee system is completed to an interim grade of 107.0 feet, NGVD. The Yazoo Area backwater levee project was completed in 1978. The Backwater area serves as a flood storage area under certain high flood conditions on the Mississippi River and is designed to overtop; therefore, the backwater levee height is set 2 feet below the height of the Mississippi River levee. Portions of the Mississippi River levee are being raised over the next 31 years to ensure the project design flood on the Mississippi River can be safely passed. This requires the backwater levee to be raised.

Satartia Area

71. The Satartia area is located generally southeast of the Yazoo Area and includes the town of Satartia, Mississippi. The area includes 27,000 acres subject to flooding with 25,000 acres cleared. The total drainage area tributary to the levee is 75 square miles and its runoff is discharged into the Yazoo River through a floodgate near the lower end of the levee. The completed Satartia Area projects include 20.2 miles of levee and the Collins Creek Drainage Structure. The Satartia Area backwater levee project was completed in 1978.

PROPOSED PUMPING PLANT FACILITY

72. The major feature of a study completed in December 1982 was a proposed pumping plant with a capacity of 17,500 cfs to be constructed approximately 0.8 mile west of the Steele Bayou drainage structure. Pumping would be initiated when interior ponding reached elevation 80 feet, NGVD, except during the period 1 December-1 March when pumping would be initiated at elevation 85 feet, NGVD. The maximum pump capacity of 17,500 cfs would have been used only during larger floods. Pump operation would begin at pumping rates of 1,000 to 2,000 cfs and increase gradually until the ponding elevation peaks and levels off.

ENVIRONMENTAL CONCERNS

73. The project area contains many natural lakes, the largest of which is Eagle Lake in Warren County. Lower elevation wooded areas are contiguous with many of these lakes. Preservation of the hunting, fishing, and other natural values of these areas is of major concern throughout the project area. Scattered small woodlands and a few large wooded areas remain. Preservation of these woodlands is also of major concern. The remaining woodlands and the lakes are important to overall environmental balance. Therefore, any project improvements must consider the interrelated needs of flood control, fish and wildlife, and other environmental factors.

74. Table 7-1 (page 7-35) presents the amount of cleared, wooded, and total acres flooded at selected frequencies of flooding for base (without-project) conditions.

DEVELOPMENT AFFECTED

75. Damageable properties and activities within the Yazoo Backwater area subject to flooding consist of both nonagricultural and agricultural development. Nonagricultural development affected by flooding includes residential, commercial, professional, industrial, public, semipublic,

recreational, and warehouse structures within portions of the built-up areas and residences, commercial structures, etc., in the rural portion of the project area. In the built-up areas, 121 residences, 19 nonresidential structures, and other development are subject to flooding. In the rural areas, 1,135 residential structures and 280 nonresidential structures are subject to flooding. Significant amounts of emergency costs are incurred by area residents, businesses, and others due to flood fighting activities, evacuation expenses, cleanup operations, and other measures in combating flooding. Operating costs of the National Flood Insurance Program (NFIP) in the Yazoo Backwater area are also significant. In addition, various public roads and bridges, built-up area streets, and private automobiles and other amenities in the project area receive damages from flooding. Agricultural development affected by flooding includes the crops produced on area farms (cotton, soybeans, rice, wheat, grain sorghum, etc.), noncrop farm development (farm drainage ditches, farm roads, land leveling, land forming, fences, farm supplies, irrigation systems, grain bins, etc.), and development associated with catfish farming operations.

NEEDS

76. Section 4 of this report, along with problems defined above, describes the flood problems in the project area, reflecting a definite need for the alleviation or reduction of flooding. Flood protection, whether full or partial, would benefit all sectors in the project area, thereby contributing to the total well-being of area residents and facilitating improvements to the national, regional, and local economies.

SECTION 4 - ALTERNATIVE PLANS OF IMPROVEMENT CONSIDERED INITIAL ARRAY

GENERAL

77. A number of flood damage reduction measures were addressed in this reformulation study. Structural as well as nonstructural measures were considered to reduce flood damages. Each alternative was formulated to reduce or alleviate flood problems and enhance the various opportunities in the economic, environmental, and social elements of the project area. Also, the no-action alternative was addressed.

NO ACTION

78. The no-action alternative was considered as a potential alternative in seeking and evaluating measures for the project area. However, the no-action approach would not meet the objective to alleviate or reduce flooding. Frequent flooding of many residences, commercial and industrial buildings, etc., and large areas of agricultural lands would continue. The area would continue to suffer from severe annual flooding events and flood-related losses, and residents would experience adverse social impacts from the constant threat and inconveniences from flooding. Local interests and project sponsors view the no-action alternative as unacceptable.

NONSTRUCTURAL ALTERNATIVES

79. Various nonstructural measures to alleviate or reduce flood damages to built-up/rural structures (residences, commercial, professional, industrial, public, semipublic, recreational, and warehouse buildings, etc.) located within the Yazoo Backwater area were also addressed. These measures consisted of (1) flood forecasting/warning systems; (2) flood plain zoning ordinances,

regulations and building codes; (3) relocation/evacuation of flood-prone structures from flood plains; and (4) floodproofing measures.

80. Flood forecasting/warning is conducted in the flood plain. Flood insurance is available for flood-prone structures. The NFIP allows property owners to purchase flood insurance at subsidized rates and mandates the county/built-up area governments to adopt and enforce flood plain regulations that require all future development to require construction above the 100-year frequency flood elevation.

81. Items (3) and (4) above were analyzed to assess their potential for economic feasibility. Floodproofing measures applicable to existing structures include waterproofing of walls and openings (doors and windows) in structures, raising (elevating) structures in place, and the construction of floodwalls or levees around flood-prone structures. The nonstructural measure of structure relocation was also examined. Relocation is the physical removal of a structure from a flood plain to an area not subject to flooding. In addition, evacuation was considered for those structures which cannot be floodproofed, raised, or relocated from the flood plain, but are acquired and demolished with a provision that the property not be reoccupied. Occupants of structures evacuated would be provided replacement housing.

82. In addition to the analysis of nonstructural measures for base hydrologic conditions, additional analyses were conducted examining the implementation of a combination of nonstructural alternatives along with flood control measures. This would tend to alleviate or reduce the remaining flood damages. In analyzing the nonstructural measures, the type construction of a structure dictates the type of floodproofing/nonstructural measure that could be employed to alleviate or reduce flood damages. For example, structures on concrete slabs generally cannot be raised; therefore, other measures such as floodproofing the walls and openings or constructing a levee must be examined. Results of the nonstructural analysis are presented in Section 8 - Economic Justification.

STRUCTURAL ALTERNATIVES

83. Various structural alternatives were considered for potential implementation in the Yazoo Backwater area. The alternatives included five pumping plant improvement plans in increments of 3,500 cfs from 10,500 cfs to 24,500 cfs and ring levees for each of the built-up areas. An additional alternative, a levee, would be constructed on both sides of the Big Sunflower River. Alternatives were eliminated in the early screening stage of the study for various reasons including the ring levee alternative. General descriptions of the detailed structural plans for main stem improvements considered in this reformulation analysis are presented in the following paragraphs. Detailed information for these plans is also presented in the Main Report. The Yazoo Backwater area flood control became the focus for a reformulation study to further examine the flood control needs of the area applying current engineering, economic, and environmental conditions and to address specific concerns and opportunities. The major task in this reformulation evaluation process was to devise alternative flood control plans which would provide significant reductions in flood damages, be environmentally and economically sensitive through risk and uncertainty analyses, and be economically justified. Additional information on the various options/considerations for reducing flood damages, etc., is presented in the Main Report.

84. An initial array of six structural alternatives were analyzed in detail for the project area to address flood control needs/opportunities. A separate evaluation of local structural flood control measures for the four built-up areas in the Yazoo Backwater area was also conducted. Results from this analysis indicated that this alternative should be dropped from further analysis. Generalized discussions of alternative plans, etc., are presented in the following paragraphs. Detailed information for all plans in the initial array evaluated is presented in the Main Report. Additional alternatives which are slightly modified versions of two of these initial array alternatives are evaluated in later portions of this analysis. Evaluation of these six initial alternatives is utilized to describe the methodology used in conducting this flood control analysis.

Plan 1

85. Plan 1 is the 10,500-cfs pumping plant alternative, which provides benefits to 102,527 cleared acres of primarily agricultural cropland (degree of protection is 40 percent).

Plan 2

86. Plan 2 is the 14,000-cfs pumping plant alternative which provides benefits to 148,138 cleared acres of primary agricultural cropland (degree of protection is 47 percent).

Plan 3

87. Plan 3 is the 17,500-cfs pumping plant alternative which provides benefits to 179,943 cleared acres of primary agricultural cropland (degree of protection is 51 percent).

Plan 4

88. Plan 4 is the 21,000-cfs pumping plant alternative which provides benefits to 205,458 cleared acres of primary agricultural cropland (degree of protection is 53 percent).

Plan 5

89. Plan 5 is the 24,500-cfs pumping plant alternative which provides benefits to 230,862 cleared acres of primary agricultural cropland (degree of protection is 56 percent).

Plan 6

90. Plan 6 is the Big Sunflower River levee alternative and includes 159 miles of levee (90 miles on the west side of the Big Sunflower River and 69 miles on the east side). This plan provides benefits to 146,806 cleared acres of primary agricultural cropland (degree of protection is 32 percent).

Plan 7

91. Plan 7 is the evaluation of the economic feasibility of providing separate flood protection measures for built-up areas in the Yazoo Backwater area. The examination/evaluation of local flood protection measures for the Yazoo Backwater built-up areas was conducted. Built-up area evaluations consisted of the determination/examination/analysis of the base (without-project) conditions flood damages for each built-up area. This analysis consisted of evaluation to determine if any of the built-up areas have substantial amounts of flood damages. For the initial array analysis, a base assumption was made that the local flood control measures considered for each built-up area would eliminate the flooding problem in each area (i.e., flood damages for existing conditions would be the flood control benefits). The four built-up areas considered for local flood protection included Rolling Fork, Cary, Eagle Lake, and Holly Bluff. The initial array analysis reflected that no built-up area contained damages large enough to justify implementation of local flood control measures. The flood control measures examined for these built-up areas included ring levee systems with associated pumping facilities and water control structures, channel improvements, etc.

SECTION 5 - FLOOD DAMAGES

GENERAL

92. Field surveys, field investigations, and data from previous studies of the Yazoo Backwater area were used to obtain data and information regarding the various types of development impacted by flooding in the project area and the extent and character of flooding and flood damages. This reformulation of the authorized Yazoo Backwater area and analyses of other alternatives were conducted for "without-project" conditions and "with-project" conditions. "Without-project" conditions for the initial array of alternatives reflect base conditions in the project area as of FY 94. "With-project" conditions reflect conditions with the 14,000-cfs pumping plant (initial array Plan 2) plan of improvement. Results from the evaluation of this alternative are used for illustrative purposes throughout this report. This evaluation of flood damages was conducted for the 2006-2055 period of economic analysis--the period of expected project economic life. In this initial evaluation, the term "current values" refers to activities/development affected by flooding in the year the analysis was conducted (1996).

93. Flood damage evaluation for this reformulation was accomplished by the use of current aerial photographs, satellite photographs and data, current stage-area and hydrologic stage-frequency data, current hydrologic data incorporating the latest daily flood historical data, the use of current field survey data, and extensive information specific to each damage category. Stage-area curves and data reflecting the latest information on the amounts of cleared agricultural lands and remaining woodlands in the project area flood plain depict the relationship between stage or elevation of flooding and area flooded. Hydrologic stage-frequency curves reflect the relationship of stage/elevation of flooding and the frequency of occurrence. Frequencies of occurrence of flooding are presented on the stage-frequency curves as percentages. Other flood analysis curves and data utilized in project evaluation included area-frequency (integration of stage-area/stage-frequency data), stage-damage (flood damage at applicable elevations of flooding), and damage-frequency (integration of flood damages and frequency data).

94. Hydrologic analyses delineate the project area--the area impacted by implementation of the Yazoo Backwater area recommended plan. The impacted area was divided into four hydrologic reaches to appropriately and more precisely reflect flooding problems. Reach 1 is the area covered by the lower sump area in previous studies and encompasses 263,275 total acres. Reach 2 is the western sector of the previously designated upper sump area--the area between the proposed Big Sunflower River levees location/placement and Deer Creek and contains 117,891 total acres. Reach 3 is bordered on the west by the proposed Big Sunflower River levees and contains most of the acreage in state parks within the project area. This area contains 107,235 total acres. Reach 4 contains the remainder of the previously designated upper sump area--the area of the eastern portion of the project area. This area contains 141,621 total acres within the Yazoo Backwater Project impacted area.

AREA FLOODED, SELECTED FLOOD FREQUENCIES

95. Table 7-1 presents the acreages flooded in the project area for various frequencies of flooding for base (without-project) conditions. Table 7-2 presents base conditions acreage flooded data by reach for the 100-year frequency flood event.

TABLE 7-1
AREA FLOODED BY SELECTED FLOOD FREQUENCIES
BASE (WITHOUT-PROJECT) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
(Thousands of Acres)

Frequency		Area Flooded				
Percent Chance of Occurrence	Year	Cleared		Wooded and Other		Total Acres
		Acres	Percent	Acres	Percent	
.01	100	360	57	270	43	630
.02	50	338	57	250	43	588
.05	20	287	55	237	45	524
.10	10	250	53	225	47	475
.20	5	209	50	210	50	419
.33	3	174	47	195	53	369
.50	2	136	44	176	56	312
1.00	1	79	41	115	59	194
2.00	0.5	34	38	56	62	90

SOURCE: Stage-area/stage-frequency data. Excludes acreages in catfish farms.

TABLE 7-2
AREA FLOODED
100-YEAR FREQUENCY FLOOD EVENT
BASE (WITHOUT-PROJECT) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI

Reach	Elevation (ft, NGVD)	Area Flooded				
		Cleared (ac)	Percent of Total (%)	Wooded and Other (ac)	Percent of Total (%)	Total (ac)
1	100.3	139,506	53	123,769	47	263,275
2	100.3	94,455	80	23,436	20	117,891
3	100.3	25,527	24	81,708	76	107,235
4	100.3	100,732	71	40,889	29	141,621
Total		360,220	57	269,802	43	630,022
USE		360,000	--	270,000	--	630,000

SOURCE: Current total area (unadjusted) stage-area and stage-frequency data.

AVERAGE ANNUAL ACRES FLOODED

96. A variety of flood analyses curves were utilized to determine flood damages. The area-frequency curve (data) are used to calculate average annual acres flooded for each hydrologic reach. Area-frequency data consist of the integration of stage-area data (elevation of flooding associated with area flooded) and stage-frequency data (elevation of flooding associated with frequencies of flooding/percent chance of flood occurrence). Consequently, frequencies of flooding associated with applicable flooding elevations and acres flooded (cleared, wooded, and total) are assimilated. The above data are integrated to create area-frequency relationships. Computer analyses facilitate measurement of the area under the area-frequency curve to determine average annual acres flooded. These types of flood analyses data not only consider the frequencies of past flood events, but also take into account the probability of other potential flood frequencies. Average annual cleared acres flooded are applied to damage-per-acre factors and

other data to determine annual flood damages for agricultural crops and agricultural noncrop items. Table 7-3 summarizes average annual acres flooded for without-project conditions for the Yazoo Backwater area. Table 7-4 presents the average annual acres flooded for with-project conditions for initial array Plan 2.

TABLE 7-3
AVERAGE ANNUAL ACRES FLOODED
BASE (WITHOUT-PROJECT) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI

Reach	Cleared (ac)	Wooded (ac)	Total (ac)
1	65,520	85,942	151,462
2	86,821	24,894	111,715
3	21,987	108,611	130,598
4	57,122	47,937	105,059
Total	231,450	267,384	498,834

SOURCE: Current area-frequency (unadjusted) data.

TABLE 7-4
AVERAGE ANNUAL ACRES FLOODED
INITIAL ARRAY (PLAN 2)
YAZOO BACKWATER AREA, MISSISSIPPI

Reach	Cleared (ac)	Wooded (ac)	Total (ac)
1	27,109	53,717	80,826
2	48,429	15,916	64,345
3	12,495	67,914	80,409
4	34,307	30,919	65,226
Total	122,340	168,466	290,806

SOURCE: Current area-frequency (unadjusted) data.

FLOOD DAMAGES

DAMAGE TO BUILT-UP AND RURAL PROPERTIES

97. Existing properties in a number of built-up areas and adjacent rural areas within the 100-year delineated Yazoo Backwater area are subject to flooding. Built-up areas and adjacent rural areas are flooded by overbank flooding from the Yazoo, Little Sunflower, and Big Sunflower Rivers and their tributaries. Structures affected by flooding include residences (built-up and rural), commercial and professional buildings, industrial structures, public, semipublic, recreation, and warehouse buildings. A total of 140 structures in the 4 built-up areas and 1,415 structures in adjacent rural areas are subject to flooding from a 100-year frequency flood event. Table 7-5 presents the number of built-up area structures flooded in the project area by reach. The number of rural structures subject to flooding in each hydrologic reach is presented in Table 7-6. Cumulatively, 1,555 built-up and rural structures are subject to flooding in the Yazoo Backwater project area.

TABLE 7-5
SUMMARY
NUMBER OF STRUCTURES RECEIVING FLOOD DAMAGES, BUILT-UP AREAS a/
BY REACH AND MAJOR PROPERTY CATEGORY
BASE (WITHOUT-PROJECT) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI

Built-Up Area	Residential	Nonresidential	Total
Reach 1			
Eagle Lake Community, Mississippi	102	5	107
Cary, Mississippi	--	--	--
Subtotal	102	5	107
Reach 2			
Cary, Mississippi	2	--	2
Rolling Fork, Mississippi	--	3	3
Subtotal	2	3	5
Reach 3			
Subtotal	0	0	0
Reach 4			
Holly Bluff, Mississippi	17	11	28
Subtotal	17	11	28
TOTAL AREA			
Eagle Lake, Mississippi	102	5	107
Cary, Mississippi (Reaches 1 and 2)	2	--	2
Rolling Fork, Mississippi	0	3	3
Holly Bluff, Mississippi	17	11	28
TOTAL	121	19	140

a/ Structures receiving flood damages from a 100-year frequency flood event. Output from URBAN Computer Program.

TABLE 7-6
SUMMARY
NUMBER OF STRUCTURES RECEIVING FLOOD DAMAGES, RURAL AREAS a/
BY REACH AND MAJOR PROPERTY CATEGORY
BASE (WITHOUT-PROJECT) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI

Reach	Residential	Nonresidential	Total
1	680	112	792
2	136	17	153
3	98	90	188
4	221	61	282
TOTAL	1,135	280	1,415

a/ Structures receiving flood damages from a 100-year frequency flood event. Output from URBAN Computer Program.

DAMAGES TO BUILT-UP AREA STRUCTURES AND RURAL PROPERTIES (INCLUDING RISK-BASED AND UNCERTAINTY ANALYSES)

98. Base (without-project) hydrologic conditions reflect that properties in several built-up areas and adjacent rural areas within the 100-year delineated Yazoo Backwater area are subject to flooding and flood damages. Portions of four built-up areas (Rolling Fork, Cary, Eagle Lake, and Holly Bluff) and adjacent impacted rural areas are inundated by Big Sunflower River and Yazoo River (and its tributaries) backwater flooding. A total of 2,857 residential and nonresidential structures are located within the Yazoo Backwater project area (2,320 total residential or 81 percent of total structures and 537 total nonresidential or 19 percent of total structures) (Table 7-7). Although all of the above structures are located in the project impacted area, not all of these structures are subject to flooding. Structures affected by flooding include both built-up area and rural area residences, commercial and professional, industrial, public, semipublic, and warehouse structures.

TABLE 7-7
TOTAL NUMBER OF RESIDENTIAL AND NONRESIDENTIAL STRUCTURES,
ALL REACHES a/
YAZOO BACKWATER AREA, MISSISSIPPI

Structure Category	Total Number of Structures in Project Area	Percentage of Total
Residential	2,320	81
Nonresidential	537	19
TOTAL	2,857	100

a/ All structures are not necessarily subject to inundation/flood damages by the 100-year frequency flood event in the Yazoo Backwater project area.

99. Determination of flood damages to residential, commercial, industrial, and other properties subject to flooding within the area included a comprehensive inventory (survey) to determine structural data, analyses of hydrologic data, and utilization of computer analyses to calculate flood damages to various types of structures and structure contents for without- and with-project conditions. The stage-damage data incorporated in the Vicksburg District computer program (Structure Flood Damage Computer Program (URBAN)) are based on survey data which indicate, for a specific structure value and type, the amount of flood damages sustained from any depth of flooding, including damage to the structure (damage to foundation, walls, etc.) and damage to contents (floor coverings, furniture, etc.).

100. An extensive field survey to assess current structure data was conducted in the project area for the following categories: residential, commercial, professional, industrial, public, semipublic, recreational, and warehouse. Data obtained and utilized as input to the URBAN computer program included number of structures (identified by the structure data inventory) located in the project area, structure floor elevation, number of stories, type of construction, use, and estimated structure value and content value. The value of land was excluded in the determination of structure value since land values add to the complexity of property damage value determination.

The current values of residential and nonresidential structures for without-project conditions were obtained from appraisals completed by the U.S. Army Corps of Engineers, Vicksburg District, Real Estate Division. Average values for major categories of built-up and rural properties, along with average value of contents, are presented in Table 7-8.

TABLE 7-8
AVERAGE VALUE OF STRUCTURES AND STRUCTURE CONTENTS FOR PROPERTIES WITHIN 100-YEAR FREQUENCY EVENT DELINEATION
BASE (WITHOUT-PROJECT) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
($000)

Structure Type	Built-Up Area		Rural Area		Total Area	
	Structures a/	Contents b/	Structures a/	Contents b/	Structures a/	Contents b/
Residential	29	15	21	11	50	25
Commercial	35	44	334	418	369	461
Professional	0	0	41	51	41	51
Industrial	18	20	1,196	1,351	1,214	1,372
Public	2	0	101	24	103	25
Semipublic	81	19	45	11	126	30
Recreational	5	1	11	3	16	4
Warehouse	17	21	13	16	30	38

a/ Based on July 1995 real estate appraisals updated to 1996 values.
b/ Average value of contents as a percent of structure value is as follows for the various types of structures:

Residential - 50 percent	Industrial - 113 percent	Recreational - 24 percent
Commercial - 125 percent	Public - 24 percent	Warehouse - 125 percent
Professional - 125 percent	Semipublic - 24 percent	

101. Based on project area hydrologic and structure floor elevation data, the URBAN computer program determines depth of flooding for each structure and computes structure and structure-specific contents value. URBAN computes structure damage values utilizing the input of structure value, content percentage of structure values, and depth-damage relationships (based on percentages of structure values inserted into the program) from predetermined samples of area structure flood depths and corresponding damages. Structures are evaluated for damages by hydrologic (water surface) profiles of actual structure location by hydraulic reach and source of flooding. Flooding depth data are then used in conjunction with programmed depth-damage data for specific structure use and type of construction to calculate structure and contents damage. Depth-damage relationships for the residential and nonresidential structures were developed by CH_2M Hill, Inc., for the U.S. Army Corps of Engineers, New Orleans District. These depth-damage data, presented in Table 7-9, were determined to be representative of the actual flood depth-damage relationships which occur in the Yazoo Backwater area. A variety of factors including structure type, terrain, hydrologic, and other characteristics provides the basis for this determination. The type of terrain in the Yazoo Backwater area is similar to that used to develop the New Orleans-based model: low water velocity in each reach; comparable water depth and duration; similar construction design, techniques, and materials; etc. Consideration of these factors by economists, hydrologists, and real estate specialists strongly supports use of the CH_2M Hill depth-damage data for these reformulation analyses.

102. Damage to contents was calculated with contents based on a percentage of structure value. For residential structures, contents were considered to be 50 percent of structure value. These determinations were based on discussions with insurance agents that stated that Homeowner III policies (the currently preferred homeowners' policy by mortgage lienholders and many homeowners) provide no less than 50 percent of structure value for contents' replacement. Replacement costs and protection are tending to increase rather than decline. Policies containing 70 and 75 percent contents' coverage are becoming the norm rather than the exception.

TABLE 7-9
CH_2M HILL FLOOD DEPTH-DAMAGE RELATIONSHIP DATA a/
RESIDENTIAL AND NONRESIDENTIAL-TYPE STRUCTURES FOR VARIOUS SELECTED STRUCTURE VALUES
YAZOO BACKWATER AREA, MISSISSIPPI

Flood Depth (ft)	Single Story Without Basement		Two-Story Without Basement		Multistory Without Basement		Mobile Home		Nonresidential Structures	
	Structure Value $25,000-$49,999		Structure Value $25,000-$49,999		Structure Value $50,000 and Over		Structure Value $11,000 and Over		Structure Value $50,000 and Over	
	Damage (Percent)		Damage (Percent)		Damage (Percent)		Damage (Percent)		Damage (Percent)	
	Structure (%)	Contents b/ (%)	Structure (%)	Contents b/ (%)	Structure (%)	Contents b/ (%)	Structure (%)	Contents b/ (%)	Structure (%)	Contents b/ (%)
-2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-0.5	5.0	0.0	5.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0
0.0	10.5	0.0	5.5	0.0	5.5	0.0	20.0	0.0	4.9	14.8
0.5	19.0	18.0	9.3	18.0	9.3	18.0	42.0	18.0	8.6	23.9
1.0	31.5	27.0	18.0	27.0	18.0	27.0	85.0	27.0	11.9	31.2
2.0	38.5	44.0	20.0	44.0	20.0	44.0	91.0	44.0	16.7	43.1
3.0	40.5	54.0	22.0	54.0	22.0	54.0	99.0	54.0	19.5	52.9
4.0	45.8	63.0	25.0	63.0	25.0	63.0	100.0	63.0	21.4	60.7
5.0	50.5	68.0	27.0	68.0	27.0	68.0	100.0	68.0	22.1	66.6
6.0	53.5	73.0	29.0	73.0	29.0	73.0	100.0	73.0	22.3	70.6
7.0	53.5	75.0	29.3	75.0	29.3	75.0	100.0	75.0	23.0	73.4
8.0	58.8	78.0	31.5	78.0	31.5	78.0	100.0	78.0	24.7	75.5
9.0	58.8	78.0	36.5	78.0	36.5	78.0	100.0	78.0	27.3	77.0

TABLE 7-9 (Cont)

Flood Depth (ft)	Single Story Without Basement		Two-Story Without Basement		Multistory Without Basement		Mobile Home		Nonresidential Structures	
	Structure Value $25,000-$49,999		Structure Value $25,000-$49,999		Structure Value $50,000 and Over		Structure Value $11,000 and Over		Structure Value $50,000 and Over	
	Damage (Percent)		Damage (Percent)		Damage (Percent)		Damage (Percent)		Damage (Percent)	
	Structure (%)	Contents b/ (%)	Structure (%)	Contents b/ (%)	Structure (%)	Contents b/ (%)	Structure (%)	Contents b/ (%)	Structure (%)	Contents b/ (%)
9.5	58.8	78.0	40.5	78.0	40.5	78.0	100.0	78.0	29.0	77.6
10.0	58.8	79.0	44.8	78.0	44.8	78.0	100.0	79.0	30.8	78.2
11.0	58.8	79.0	44.8	79.0	44.8	79.0	100.0	79.0	35.2	79.0
12.0	58.8	79.0	45.0	79.0	45.0	79.0	100.0	79.0	38.8	79.5
13.0	58.8	79.0	46.5	79.0	46.5	79.0	100.0	79.0	42.1	79.9
14.0	58.8	79.0	48.5	79.0	48.5	79.0	100.0	79.0	42.1	80.2
15.0	58.8	79.0	48.5	79.0	48.5	79.0	100.0	79.0	42.1	80.4
16.0	58.8	79.0	48.5	79.0	48.5	79.0	100.0	79.0	42.1	80.4
17.0	58.8	79.0	48.5	79.0	48.5	79.0	100.0	79.0	42.1	80.4

a/ Input data, URBAN computer program.
b/ Content damagable value based on portion of structure value (treated as a percentage of 100 percent) allowable and determined by current regulations and guidlines.

103. Results of the flood damage analyses of built-up areas and rural properties in the Yazoo Backwater area indicate that with the occurrence of a 100-year frequency flood event in the area, a total of 1,555 structures are expected to be impacted or receive flood damages. Total numbers of 140 structures in the built-up areas and 1,415 structures in rural areas are subject to flooding and flood damage from a 100-year frequency flood event. Table 7-5 presented a summary of the number of structures flooded in the project area by reach in the built-up areas. The number of rural structures subject to flooding is summarized by hydrologic reach in Table 7-6. Table 7-10 presents a summary of the total number of built-up and rural as well as residential and nonresidential structures subject to flooding from a 100-year frequency flood event in the project impacted area.

Flood Damages for Selected Frequencies

104. Output from the URBAN computer program provides an analysis of the number of structures as well as an estimate of damages for various flood frequencies. Estimated flood damages and number of structures flooded for selected flood frequencies by built-up and rural areas are presented in Table 7-11 for base (without-project) conditions. Data in Table 7-11 indicate approximately $17.9 million in flood damages would occur to built-up and rural properties in the project area from a 100-year frequency flood event for existing conditions. With implementation of Plan 2, this amount would be reduced to approximately $2.6 million (Table 7-12).

TABLE 7-10
SUMMARY
TOTAL NUMBER OF STRUCTURES RECEIVING FLOOD DAMAGES,
BUILT-UP AND RURAL AREAS a/
BY REACH AND MAJOR PROPERTY CATEGORY
BASE (WITHOUT-PROJECT) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI

Reach	Residential	Nonresidential	Total
Reach 1			
Built-Up Area	102	5	107
Rural Area	680	112	792
Subtotal	782	117	899
Reach 2			
Built-Up Area	2	3	5
Rural Area	136	17	153
Subtotal	138	20	158
Reach 3			
Built-Up Area	0	0	0
Rural Area	98	90	188
Subtotal	98	90	188
Reach 4			
Built-Up Area	17	11	28
Rural Area	221	61	282
Subtotal	238	72	310
TOTAL AREA			
Built-Up Area	121	19	140
Rural Area	1,135	280	1,415
TOTAL	1.256	299	1.555

a/ Structures receiving flood damages from a 100-year frequency flood event. Output from URBAN Computer Program.

TABLE 7-11
NUMBER OF RESIDENTIAL AND NONRESIDENTIAL STRUCTURES
FLOODED AND ASSOCIATED
FLOOD DAMAGES, SELECTED FREQUENCIES OF FLOODING
BASE (WITHOUT-PROJECT) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI

Frequency (yr)	Number of Structures			Damages a/		
	Built-Up Area	Rural Area	Total Area	Built-Up Area ($000)	Rural Area ($000)	Total Area ($000)
100	140	1,415	1,555	1,271	16,614	17,885
50	95	1,032	1,127	665	10,666	11,331
25	47	685	732	287	7,489	7,776
10	15	411	426	66	4,069	4,135
5	2	189	191	7	1,737	1,744
2	0	27	27	0	100	100
1	0	8	8	0	63	63
Average Annual Damage				108	1,640	1,748
Damage Per Structure ($) b/				771	1,159	1,124

a/ Based on July 1995 real estate appraisals updated to 1996 values.
b/ Actual dollar values (not in thousands of dollars).

TABLE 7-12
NUMBER OF RESIDENTIAL AND NONRESIDENTIAL STRUCTURES
FLOODED AND ASSOCIATED
FLOOD DAMAGES, SELECTED FREQUENCIES OF FLOODING
WITH PROJECT (PLAN 2) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI

Frequency (yr)	Number of Structures			Damages a/		
	Built-Up Area	Rural Area	Total Area	Built-Up Area ($000)	Rural Area ($000)	Total Area ($000)
100	6	274	280	18	2,574	2,592
50	2	159	161	6	1,561	1,567
25	2	79	81	b/	816	816
10	0	24	24	0	95	95
5	0	14	14	0	28	28
2	0	0	0	0	0	0
1	0	0	0	0	0	0
Average Annual Damage				5	176	181
Damage Per Structure c/				833	642	646

a/ Based on July 1995 real estate appraisals updated to 1996 values.
b/ Less than $500.
c/ Actual dollar values (not in thousands of dollars).

Assessment of Most Probable Future
Land Use and Related Damages

105. Examination of the alternative site determination (potential for locating buildings at sites outside flooded areas) does not apply in this analysis since activities (housing development, etc.) desiring to use the flood plain are doing so without the additional protection provided by any of the alternative plans of improvement considered in this report. The Yazoo Backwater area currently receives protection from Mississippi River backwater flooding from the existing Yazoo

Backwater levee project. The construction of the Yazoo Backwater levees, connecting channel, and flood control/structures was completed in 1978. The two major structures are the Steele Bayou structure and the Big Sunflower River structure.

106. Future land use assessment included consideration of the requirements of the Flood Disaster Protection Act of 1973 (Public Law 93-234), now administered by the National Flood Insurance Program (NFIP). Consequently, new structures locating in the project area are required to be constructed with a floor elevation above the established 100-year flood frequency event elevation. The requirements of the Flood Disaster Protection Act of 1973 (Public Law 93-234) is taken into account in this analysis. In assessing future land use, site development costs are greater than in protected areas since fill costs are often incurred on these properties to raise the floor elevation above the 100-year flood frequency elevation. For without- and with-project conditions in the built-up areas, development is currently occurring in areas now subject to flooding. These areas would receive protection from construction/implementation of Plan 2. For example, in built-up areas of Reach 1, implementation of Plan 2 would provide a 91 percent reduction in annual flood damages. In Reaches 2 and 4, the built-up areas would receive almost 100 percent protection. In rural areas, implementation of Plan 2 would provide for reduction in annual flood damages to structures ranging from 88 percent in Reach 3 to 96 percent in Reach 4. Agricultural lands adjacent to built-up areas continue to be converted slowly to nonagricultural use. Based on projected population increases for the study (Socioeconomic Profile), no significant additional future residential development is expected to occur in the area. Therefore, for this analysis, the number of structures and flood damages to residential and nonresidential structures in the built-up and rural areas is held constant (no projected increase) for future time periods.

Annual Flood Damage to Built-Up and Rural Structures

107. Table 7-13 provides a summary of the results of the output from the URBAN computer program for built-up properties. This table presents the estimated annual flood damages for the

TABLE 7-13
AVERAGE ANNUAL FLOOD DAMAGE TO BUILT-UP AREA STRUCTURES
BY REACH AND MAJOR PROPERTY CATEGORY a/
BASE (WITHOUT-PROJECT) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 $ Values)
($000)

Built-Up Area	Residential	Nonresidential	Total
Reach 1			
Eagle Lake Community, Mississippi	59	1	60
Cary, Mississippi	1	b/	1
Subtotal	60	1	61
Reach 2			
Cary, Mississippi	2	22	24
Rolling Fork, Mississippi	7	4	11
Subtotal	9	26	35
Reach 3			
Subtotal	b/	b/	b/
Reach 4			
Holly Bluff, Mississippi	8	4	12
Subtotal	8	4	12
TOTAL AREA			
Eagle Lake, Mississippi	59	1	60
Cary, Mississippi (Reaches 1 and 2)	3	22	25
Rolling Fork, Mississippi	7	4	11
Holly Bluff, Mississippi	8	4	12
TOTAL	77	31	108

a/ Output from URBAN Computer Program.
b/ Less than $500.

impacted built-up areas within the Yazoo Backwater area. Table 7-14 presents a summary of the estimated (current year, 1996) annual flood damages for the rural residential and nonresidential structures within each hydrologic reach of the project area. Accounting for the probability of flood frequencies (chance for occurrence) in the area and an analysis of flood damages to structures and structure contents, flood damages to built-up and rural structures are estimated at $1,748,000 annually. A summary of the average annual structure flood damage values is presented in Table 7-15. Six percent of the computed annual damages occur in the built-up areas affected by flooding within the project area. Of the $108,000 annual flood damage in built-up areas, 71 percent occurs to residential properties. The remaining 29 percent occurs to nonresidential properties, which consist of commercial, industrial, public, semipublic, professional, recreational, and warehouse properties. Approximately 94 percent ($1,640,000) of the total built-up and rural damages in the project occurs to rural properties. Most of the annual rural flood damages (56 percent) occur to rural residences, with the remainder (44 percent) occurring primarily to rural commercial establishments.

TABLE 7-14
AVERAGE ANNUAL FLOOD DAMAGE TO RURAL AREAS
BY REACH AND MAJOR PROPERTY CATEGORY a/
BASE (WITHOUT-PROJECT) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 $ Values)
($000)

Reach	Residential	Nonresidential	Total
1	630	580	1,210
2	94	16	110
3	124	88	212
4	74	34	108
TOTAL AREA	922	718	1,640

a/ Output from URBAN Computer Program.

TABLE 7-15
ANNUAL FLOOD DAMAGES TO BUILT-UP AND RURAL AREA STRUCTURES a/
BASE (WITHOUT-PROJECT) CONDITIONS AND
WITH-PROJECT (PLAN 2) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 $ Values)
($000)

Item/Year	Base (Without-Project) Conditions	With-Project NED Plan Conditions
1996 (Current Year)		
Built-Up Area		
Residential	77	5
Nonresidential	31	b/
Total	108	5
Rural		
Residential	922	87
Nonresidential	718	89
Total	1,640	176
Total Area		
Residential	999	92
Nonresidential	749	89
Total	1,748	181
2006 c/ (Base Year)		
Built-Up Area	108	5
Rural Area	1,640	176
Total	1,748	181
2055 c/		
Built-Up Area	108	5
Rural Area	1,640	176
Total	1,748	181

a/ Output from URBAN Computer Program.
b/ Less than $500.
c/ Flood damages associated with built-up area and rural area flooding are held constant over the estimated project economic life (2006-2055).

Annual Built-Up Area and Rural Area Flood Damage for
Without- and With-Project (Plan 2) Conditions

108. Table 7-15 presents a comparison of annual built-up and rural area structure flood damages for without- and with-project (Plan 2) conditions. With implementation of Plan 2, flood damages to structures (residences, commercial and industrial buildings, public and semipublic buildings, etc.) in the built-up areas would be reduced from $108,000 annually to $5,000 annually, a 95 percent reduction. In the rural sector of the project area, annual damages to residences, etc., would be reduced from $1,640,000 annually to $176,000 annually, an 89 percent reduction. For the total project area, Plan 2 would reduce built-up area and rural area flood damages from $1,748,000 annually to $181,000, a 90 percent reduction. Table 7-15 also presents values for the 2006 and 2055 future years--same as current year 1996 values. The number of built-up and rural area structures subject to flooding was held constant for future time periods. The project area is not eligible for and does not include application of an "affluence factor" for increasing contents value for structures in the project area.

FLOOD DAMAGES FROM A CATASTROPHIC FLOOD EVENT

109. Base hydrologic conditions reflect that a catastrophic flood such as a 100-year frequency flood event would inundate portions of the four built-up areas. Approximately 1,555 structures would be flooded from an event of this magnitude. Approximately 81 percent of these structures are residences and the remaining 19 percent are nonresidential structures, including commercial, industrial, professional, recreational, warehouse, public, and semipublic buildings. Flood damages to residential and nonresidential structures from a catastrophic event would amount to approximately $17.9 million.

110. A flood of this magnitude would create disruption of essential services in the built-up and rural areas. These impacted services primarily include water supply, sanitary systems, and fire protection. Should floodwaters inundate the water supply system, pollution of this system for these impacted areas may occur, creating health hazards. However, with adequate warning time,

the public and private water supply systems could be closed or otherwise prepared so that system damages or health hazards would be minimal. During a catastrophic flood event, interrupted or contaminated water supplies could be supplemented by nearby unaffected systems. Added health hazards and inconveniences would also occur due to dysfunction of sanitary sewerage systems and individual septic tanks. Pumps and other sanitary sewerage system equipment could be shut off and prepared, reducing damages. Municipal and rural sanitary systems not actually flooded could also be affected by the backup and overflows of the system into other areas.

111. Efficiency of fire protection for the impacted areas could also be reduced. Any fire in the flooded areas could have major consequences due to lack of adequate water supplies in some areas and from flooding at a depth preventing the use of firefighting equipment (trucks, etc.). However, with adequate pumping equipment and accessibility to fires, floodwater could be used to extinguish fires. For without-project flooding conditions, electrical power and power facilities should not be affected significantly.

Risk-Based Analyses

112. Based on risk and uncertainty procedures outlined in Engineer Circular 1105-2-205, the Water Resources Support Center and the Hydrologic Engineering Center utilized LOTUS and @RISK computer software to develop several economic and hydrologic models, or templates, to be used in the analyses of structural flood damages. Not only do these programs analyze the reliability and effectiveness of various project improvements, but they also account for uncertainties associated with various economic and hydrologic parameters, such as structure and content values, structure floor elevations, depth-damage relationships, and stage-frequency data. The traditional concept of integrating flood depths, frequency, and damage data is still utilized in the determination of flood damages except, with the risk approach, an attempt is made to

explicitly quantify the uncertainty variables. Depth-damage and damage-frequency data from output of the URBAN Computer Program were used as input for the risk and uncertainty analyses.

113. In the economic evaluation of structure flood problems in the Yazoo Backwater area, two types of @RISK models were used. An economic model was utilized to develop a stage-damage relationship and corresponding uncertainty for the base (without-project) hydrologic conditions in each flood damage reach. Hydrologic templates, based on specific types of project improvements, were integrated into stage-damage and stage-frequency relationships to evaluate flood damages for each set of project conditions. In the Yazoo Backwater area, a recently developed template for levee analysis was utilized (albeit to a limited degree due to height restrictions) to evaluate the effectiveness of the levee improvement alternative (Alternative 6). A non-levee analysis template was used to evaluate the various pumping plant alternatives in the initial array. A detailed description of risk-based methodology and analysis is presented as Attachment 7A.

Stage-Damage Analyses

114. The economic stage-damage template utilizes a simulation technique to incorporate risk and uncertainty into the calculation of flood damages for specified flood events. Multiple iterations were performed to select or sample from the full range of possible values for the various input variables (e.g., structure values, contents values, floor elevations, etc.). This routine was accomplished simultaneously for each structure and for each variable tested. The resulting stage-damage relationship and corresponding uncertainty were then integrated with the stage-frequency relationship and its corresponding uncertainty in the appropriate hydrologic template to determine the expected without- and with-project flood damages.

115. The results of the stage-damage analysis for existing conditions on structural flood damages in the Yazoo Backwater area are presented in Tables 7-16 and 7-17. Corresponding standard deviations were also calculated in the Risk-based framework which represent any uncertainties in key hydrologic or economic parameters (presented in Attachment 7-A). The standard deviation is a measure of variability that is extremely useful, not only for comparing sets of measurements, but also for describing a single set of measurements.

TABLE 7-16
RESULTS OF THE STAGE-DAMAGE STRUCTURAL ANALYSIS,
REACHES 1 AND 2
BASE (WITHOUT-PROJECT) CONDITIONS
RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 $ Values)

Structural Stage-Damage by Reach					
Stage (ft, NGVD)	Reach 1 a/ ($000)		Stage (ft, NGVD)	Reach 2 a/ ($000)	
	Built-Up Area	Rural Area		Built-Up Area	Rural Area
87.0	--	11.9	87.8	--	--
91.0	--	175.2	91.8	--	1.9
94.8	33.9	2,005.7	95.3	--	124.2
96.3	150.4	4,234.4	96.8	--	331.1
98.0	174.8	7,799.3	98.6	--	876.8
99.2	911.4	11,499.7	99.5	154.6	1,379.0
100.3	1,486.3	15,980.0	100.3	404.9	2,001.3

a/ Output from Risk-based analysis program.

TABLE 7-17
RESULTS OF THE STAGE-DAMAGE STRUCTURAL ANALYSIS,
REACHES 3 AND 4
BASE (WITHOUT-PROJECT) CONDITIONS
RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 $ Values)

Structural Stage Damage by Reach					
Stage (ft, NGVD)	Reach 3 a/ ($000)		Stage (ft, NGVD)	Reach 4 a/ ($000)	
	Built-Up Area	Rural Area		Built-Up Area	Rural Area
87.8	--	5.8	87.8	--	--
91.8	--	99.7	91.8	--	--
95.3	--	504.4	95.3	--	37.3
96.8	--	926.5	96.8	--	191.9
98.6	--	1,663.4	98.6	62.8	936.3
99.5	--	2,108.7	99.5	149.1	1,761.2
100.3	--	2,534.9	100.3	280.0	2,821.1

a/ Output from Risk-based analysis program.

Levee Analyses

116. Structural alternatives proposed for possible implementation in the Yazoo Backwater area to alleviate flood damages include analyzing new levee improvements for the project area. The @Risk analyses were not directly utilized on this alternative, since the Big Sunflower River levee is sized by the 27.8-mile Yazoo Backwater levee system through documentation printed in House Document 359, 77th Congress. This levee system was completed in 1978 to an interim grade of 107.0 feet, NGVD. A standard URBAN (structure flood damage computer) analysis was

completed to determine the damages remaining (flood damage prevented benefits) for the Big Sunflower River levees.

Future Flood Damages to Structures

117. With limits on content-to-structure ratio of 50 percent and other limitations, flood damages to built-up and rural area structures for without- and with-project conditions are not projected to increase for future time periods. Thus, flood damages will remain constant over the expected economic life of the project (Table 7-18).

Total Structural Flood Damages

118. The results of the Risk-based analysis of structural damages in the Yazoo Backwater area (with- and without-flood reduction measures considered for this analysis) are summarized in Tables 7-18 and 7-19. Estimated annual damages to built-up and rural structures for base (without-project) conditions are approximately $2.1 million for the total project area. Remaining structural flood damages with the various alternative plans range from $73,000 for Alternative Plan 5 (24,500-cfs pump) to $510,000 for Alternative Plan 1 (10,500-cfs pump).

TABLE 7-18
ANNUAL FLOOD DAMAGES TO BUILT-UP AND
RURAL AREA STRUCTURES, ALL REACHES
BASE (WITHOUT-PROJECT) AND
WITH-PROJECT (PLAN 2) CONDITIONS
RESULTS OF RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 Values)
($000)

Item/Year	Base (Without-Project Conditions)	With-Project (Plan 2) Conditions a/
1996 (Current Year)		
Built-Up Areas	110	10
Rural Areas	1,962	271
Total Area	2,072	281
2006 b/ (Base Year)		
Built-Up Areas	110	10
Rural Areas	1,962	271
Total	2,072	281
2055 b/		
Built-Up Areas	110	10
Rural Areas	1,962	271
Total	2,072	281

a/ Alternative Plan 2, 14,000-cfs pumping plant.
b/ Flood damages held constant over project economic life (2006-2055). Year 2006 is base year of project or first full year in which project benefits occur.

TABLE 7-19
ESTIMATED ANNUAL STRUCTURAL FLOOD DAMAGES
WITHOUT- AND WITH-PROJECT CONDITIONS
RISK AND UNCERTAINTY ANALYSIS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 Values)
($000)

Item	Flood Damages by Project Reach a/				
	Reach 1	Reach 2	Reach 3	Reach 4	Total
Existing (Without-Project) Flood Damages	1,465	196	249	162	2,072
With-Project Flood Damages:					
Pumping Plant Alternatives					
Alternative Plan 1, 10,500-cfs	374	40	65	31	510
Alternative Plan 2, 14,000-cfs	213	19	36	13	281
Alternative Plan 3, 17,500-cfs	119	10	21	7	157
Alternative Plan 4, 21,000-cfs	81	8	13	5	107
Alternative Plan 5, 24,500-cfs	55	5	9	4	73
Levee Alternatives					
Alternative Plan 6, Levee	144	3	96	76	319

a/ Output from Risk-based analysis.

EMERGENCY COSTS, BUILT-UP AND RURAL AREAS

119. Emergency costs include such items as evacuation and reoccupation costs; flood-fighting expenses; costs for emergency shelter and food for evacuees; state and Federal disaster relief; increased expense of normal operations; increased costs of police, fire, and/or military patrol; and

losses due to abnormal depreciation of equipment; e.g., fire trucks and fire equipment, patrol cars, bulldozers, etc., resulting from catastrophic flooding. Specific flood-fighting activities include sandbagging, road barricades, pumps and associated equipment, levees, transport of fill dirt, etc., and other requirements resulting from flooding. These are expenses or costs borne by affected residents and property owners, local or state governments or agencies, other Federal agencies, or national organizations.

120. Expenses for evacuation, reoccupation, individual flood-fighting efforts, and abnormal depreciation are borne mostly by affected individual residents and property owners, while other expenses, such as emergency relief, are borne by local, state, or Federal agencies and organizations. Organizations such as the American Red Cross incur significant costs from providing emergency shelter, food, and other items for flood victims.

121. Emergency costs were calculated based on the number of structures flooded by frequency applied to an emergency cost value per structure. Updated unit values of $880 for residential properties and $1,446 for commercial and industrial structures were developed by compiling actual emergency costs expended based on data collected for the study area from various local, state, and Federal agencies relative to emergency operations performed during previous studies of adjacent areas for the 1990 and 1991 flood events. The number of structures affected was combined with the emergency cost value per structure, by type, to develop damage-frequency curves for each area. These curves were then utilized in determining the total average annual emergency costs expended for each affected area.

122. For base (without-project) conditions, 4 percent, or $6,500, of average annual flood expenses occur in built-up areas, while 96 percent ($162,700 annually) occur in rural sectors of the project area. Emergency costs associated with rural structure flooding are presented in Table 7-20 by reach. Total emergency costs are estimated at $169,200 annually--54 percent are emergency costs sustained by residential properties.

TABLE 7-20
EMERGENCY COSTS ASSOCIATED WITH RURAL FLOODING
BY MAJOR PROPERTY CATEGORY, BY REACH
BASE (WITHOUT-PROJECT) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 $ Values)

Reach	Residential	Nonresidential	Total
1	59,700	34,100	93,800
2	8,600	2,000	10,600
3	13,100	32,000	45,100
4	6,400	6,800	13,200
Total	87,800	74,900	162,700

123. Table 7-21 provides a comparison of emergency costs for without-project conditions and for with-project conditions (Plan 2). With Plan 2, the total annual emergency costs are reduced from $169,200 to $17,100, a reduction of 90 percent. Average annual emergency costs for built-up areas are reduced by Plan 2 from $6,500 to $200, while average annual emergency costs for the total area are reduced from $162,700 to $16,900 by Plan 2. This reflects a reduction of 97 percent for built-up area properties and 90 percent for the rural sector.

TABLE 7-21
TOTAL ANNUAL EMERGENCY COSTS ASSOCIATED
WITH BUILT-UP/RURAL AREA FLOODING
BASE (WITHOUT-PROJECT) AND WITH-PROJECT (PLAN 2) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 Values)
($)

Category	Base (Without-Project) Conditions	With-Project (Plan 2) Conditions
1996 (Current Year)		
Built-Up Areas		
Residential	5,600	200
Nonresidential	900	0
Subtotal	6,500	200
Rural Areas		
Residential	87,800	6,000
Nonresidential	74,900	10,900
Subtotal	162,700	16,900
Total Area		
Residential	93,500	6,200
Nonresidential	75,700	10,900
Total	169,200	17,100
2006 a/ (Base Year)		
Built-Up Areas	6,500	200
Rural	162,700	16,900
Total	169,200	17,100
2055 a/		
Built-Up Areas	6,500	200
Rural	162,700	16,900
Total	169,200	17,100

a/ Emergency costs associated with built-up area/rural structural flooding are held constant over the estimated project economic life (2006-2055).

NFIP OPERATING COSTS, BUILT-UP AND RURAL AREAS

124. The NFIP was enacted by Congress in 1968 to provide flood insurance through a joint Government-industry program that was previously unavailable from private insurance companies at reasonable rates. Communities must meet eligibility requirements by adopting certain flood plain management regulations which must be consistent with Federal criteria and reduce or avoid flooding in connection with future construction in the flood plain.

125. The NFIP is highly subsidized and seeks immediately to assure wiser future flood plain management rather than obtaining adequate premiums for coverage provided. Communities entering the program generally do so in two stages. Initially, communities become eligible through the Emergency Program, which offers only half the program's coverage limits. Secondly, communities can enter the Regular Program after a flood insurance rate study has been conducted. For the Regular Program, full coverage limits are available. Currently, the residents of the four built-up areas and adjacent rural flood plain areas of the Yazoo Backwater area can participate in the NFIP.

126. The costs of administering these flood insurance policies for flood-prone areas are a cost to the nation's taxpayers. Currently, NFIP operating cost for each policy each year is $122 as per Economic Guidance Memorandum No. 96-3, 13 February 1996. Based on available data for the project area prepared by the Federal Emergency Management Agency (FEMA), flood insurance is not maintained on all the residences, commercial buildings, and other structures subject to flooding by a 100-year frequency flood event in the project area. Based on FEMA data, approximately 4 percent of the total number of built-up structures and 33 percent of the rural structures subject to flooding currently maintain flood insurance. The estimated number of built-up structures with flood insurance for without-project conditions was multiplied by the current

NFIP operating cost per flood insurance policy ($122) resulting in an annual cost of $3,600. NFIP costs for the rural area are estimated at $29,300 annually. Total NFIP costs are estimated at $32,900 annually for the project area. Table 7-22 presents a summary of estimated costs of administering flood insurance policies in the four built-up areas within the Yazoo Backwater area. Table 7-23 presents a summary of costs of administering flood insurance policies in the rural areas of the Yazoo Backwater area. Approximately 9 percent of these flood insurance program operating costs occur in the four built-up areas. This procedure was also applied to estimate NFIP operating costs for with-project conditions. The NFIP total operating costs, with implementation of Plan 2, are estimated at $5,700 annually, which reflect an 83 percent reduction in these costs. Table 7-24 presents a summary of NFIP operating costs for without-project conditions and for with-project (Plan 2) conditions.

TABLE 7-22
ESTIMATED FLOOD INSURANCE PROGRAM OPERATING COSTS
BY BUILT-UP AREA BY REACH
BASE (WITHOUT-PROJECT) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 Values)
($)

Reach	Built-Up Area	Residential	Nonresidential	Total
1	Eagle Lake	2,100	100	2,200
2	Cary	500	0	500
	Rolling Fork (East)	--	400	400
3	--	--	--	--
4	Holly Bluff	300	200	500
Total		2,900	700	3,600

TABLE 7-23
ESTIMATED FLOOD INSURANCE PROGRAM OPERATING COSTS
RURAL AREAS BY REACH
BASE (WITHOUT-PROJECT) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 Values)
($)

Reach	Residential	Nonresidential	Total
1	13,900	2,300	16,200
2	3,500	400	3,900
3	1,900	1,800	3,700
4	4,300	1,200	5,500
Total	23,600	5,700	29,300

TABLE 7-24
NFIP OPERATING COSTS
BUILT-UP/RURAL AREAS
BASE (WITHOUT-PROJECT) AND WITH-PROJECT (PLAN 2) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 Values)
($)

Property Type	Base (Without-Project) Conditions	With-Project NED Plan Conditions
1996 (Current Year)		
Built-Up Areas		
Residential	2,900	100
Nonresidential	700	-- a/
Subtotal	3,600	100
Rural Areas		
Residential	23,600	4,300
Nonresidential	5,700	1,300
Subtotal	29,300	5,600
Total Area		
Residential	26,500	4,400
Nonresidential	6,400	1,300
Total	32,900	5,700
2006 (Base Year)		
Built-Up Areas	3,600	100
Rural	29,300	5,600
Total	32,900	5,700
2055		
Built-Up Areas	3,600	100
Rural	29,300	5,600
Total	32,900	5,700

a/ Less than $100.

FLOOD DAMAGE TO STREETS, ETC., BUILT-UP AREAS

127. The overall analysis of transportation facility losses involved determining the number of units adversely impacted by frequency and the application of these data to a loss per unit value for various types of facilities involved. Aerial photographs, topographic maps, hydrologic data, and a delineation of the area affected were utilized in this analysis. The evaluation of street damages incorporated data from interviews with local officials. The type, location, and number of miles of streets, roads, etc., affected were based on analysis of current aerial photographs and topographic maps on which the impacted area was delineated. Local sources provided estimates of damages and effects upon specific improvements. The estimates also provided data and insight into the types of losses incurred and factual data on repair requirements, as well as construction cost estimates.

128. According to local sources, average repair cost per mile of paved roadway is approximately $70,000. The assumption that flooded roadways would require resurfacing was applied for both without- and with-project conditions. Repair costs were applied to the number of road miles impacted to determine estimated damages for each built-up area in the project area. Estimated flood damages to built-up area streets for base (without-project) conditions and for with-project initial array (Plan 2) conditions are presented in Table 7-25. Values for population increases utilized in projecting flood damages to built-up area streets are presented in Table 7-26. Data in Table 7-27 depict the projected flood damages to built-up area streets. Annual flood damage to streets for the current year (1996) are estimated at $137,600 for base (without-project) conditions. With implementation of Plan 2, the estimated current flood damage to streets in built-up areas would be $61,700 annually.

TABLE 7-25
FLOOD DAMAGE TO STREETS, ETC., BUILT-UP AREAS
BY REACH/BUILT-UP AREA
(WITHOUT-PROJECT) AND WITH-PROJECT (PLAN 2) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 $ Values)

Built-Up Area	Reach	Base (Without-Project) Conditions	With-Project (Plan 2) Conditions
Eagle Lake	1	105,200	42,600
Cary	2	4,900	3,100
--	3	--	--
Holly Bluff	4	27,500	16,000
Total		137,600	61,700

TABLE 7-26
PROJECTED POPULATION, ECONOMIC BASE STUDY AREA
YAZOO BACKWATER AREA, MISSISSIPPI

Year	Projected Population a/ (No.)	Ratio of Increase (%)
1996 (Current Year)	10,470	
		1.00105
2005 (EPCD) b/	10,481	
		1.00373
2006 (Base Year) c/	10,520	
		1.03299
2015	10,867	
		1.02605
2025	11,150	
		1.02547
2035	11,434	
		1.01373
2045	11,591	
		1.02045
2055	11,828	

a/ Population projections for the Yazoo Backwater economic base study area (Sharkey and Issaquena Counties).
b/ EPCD denotes estimated project completion date.
c/ Base year denotes first full year that benefits will be realized after project completion.

TABLE 7-27
FLOOD DAMAGE TO STREETS, ETC., BUILT-UP AREAS
BASE (WITHOUT-PROJECT) AND WITH-PROJECT (PLAN 2) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 $ Values)

Year	Base (Without-Project) Conditions	With-Project (Plan 2) Conditions
1996 (Current Year)	137,600	61,700
2006 (Base Year)	138,300	62,000
2015	142,800	64,000
2025	146,500	65,700
2035	150,300	67,400
2045	152,300	68,300
2055	155,500	68,800

FLOOD DAMAGES TO PUBLIC ROADS AND BRIDGES

129. Public road and bridge damage estimates are based on available field survey data and applicable hydrologic data for the project area. A private consultant firm previously completed surveys to obtain detailed road and bridge damage data for historical flood frequency events. These damage data were derived for areas that were segmented based on flowage/drainage watershed delineations termed Water Resources Units (WRU). Damage data specific to each WRU were compiled into damage-frequency data by coupling the damage data to frequencies of flood occurrences. Appropriate WRU's that represent the project area were identified by reach, and from the above data, current road and bridge damage per average annual total acre values were developed.

130. Present (1996) road and bridge damage value per-average-annual acre flooded for each reach was multiplied by the average annual total acres flooded without- and with-project conditions for each respective reach to determine present annual road and bridge damages, as presented in Table 7-28. With-project (Plan 2) implementation, flood damages to public roads and bridges in the Yazoo Backwater area would be reduced by 41 percent (from an estimated $1,917,600 for without project to $1,123,300 annually with Plan 2).

TABLE 7-28
FLOOD DAMAGE TO PUBLIC ROADS AND BRIDGES, BY REACH
BASE (WITHOUT-PROJECT) AND WITH-PROJECT (PLAN 2) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 $ Values)

Reach	Base (Without-Project) Conditions	With-Project (Plan 2) Conditions
1	523,200	279,800
2	448,600	258,900
3	523,700	323,000
4	422,100	261,600
Total	1,917,600	1,123,300

131. Future damage values for public roads and bridges are based on ratios of increase in population projections prepared for the Yazoo Backwater economic base area. Additional information concerning population data for the Yazoo Backwater study area is presented in Appendix 8. Values for population increases utilized in projecting road and bridge damages are presented in Table 7-26. Present and future damages to public roads and bridges for without-project conditions and with-Plan 2 conditions are displayed in Table 7-29.

TABLE 7-29
PROJECTED FLOOD DAMAGES TO PUBLIC ROADS AND BRIDGES
BASE (WITHOUT-PROJECT) AND WITH-PROJECT (PLAN 2) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 $ Values)

Year	Base (Without-Project) Conditions	With-Project (Plan 2) Conditions
1996 (Current Year)	1,917,600	1,123,300
2006 (Base Year)	1,926,800	1,128,700
2015	1,990,400	1,165,900
2025	2,042,200	1,196,300
2035	2,094,200	1,226,800
2045	2,123,000	1,243,600
2055	2,166,400	1,269,100

AGRICULTURAL CROP ANALYSES

132. As stated previously, inundation reduction and intensification benefits are included in the agricultural crop analyses. Inundation reduction benefits are project-induced reductions in flood damages to existing development and to future development that would occur in the absence of a project. Intensification benefits result from potentials created by the project--from improved management practices measured in terms of increases in net returns to land. These increases reflect the beneficial impact of a water resources project plan on production activities, which allow more effective farming and land utilization, thereby increasing net returns. The reduction of flood risk allows farmers to more efficiently employ sound agricultural practices, improving production levels.

133. Flood risk is a major problem which often severely limits agricultural activities. Frequent flooding precludes/limits various crop production improvement activities necessary to maximize net returns. This detrimental impact from flooding also extends to less frequently flooded areas.

Failure to evacuate water from the more flood-prone areas prevents the effective use of higher elevation areas, increasing cropping delays in these areas.

134. Due to the soil wetness problems created or magnified by flooding, farmers are prevented from planning and selecting the highest yielding crop varieties or planting on optimum dates. By planting recommended varieties at the appropriate time, improved performance can be achieved from periods of more favorable plant growth, less insect pressure, favorable harvest conditions, and an increased number of days suitable for various crop production operations. Research performed at MSU indicates that delays from the optimum timeframe for planting soybeans in the Delta area normally result in significantly reduced yields.

135. Due to the risk and uncertainty associated with areas of frequent flooding, farmers are unable to properly plan their farming operation. Farmers generally make plans prior to the spring planting season and translate these plans into commitments with suppliers to purchase seeds, fertilizer, and chemicals as well as tractors, trucks, and other associated agricultural equipment. Financial needs are arranged through lending institutions based on anticipated crop types and activities, considering flood risk and other elements.

136. Expected agricultural flood damages for existing conditions and with proposed flood control measures installed were estimated utilizing the risk and uncertainty guidance in EC 1105-2-205, Risk Analysis Framework for Evaluation of Hydrology/Hydraulics and Economics in Flood Damage Reduction Studies, 25 February 1994. The specific purpose of this portion of the analysis was to quantify, to the extent possible, any uncertainties inherent in the flood damage evaluation which would aid in making a decision to invest in a flood protection project for the Yazoo Backwater area (see Attachment 7B, Agricultural Risk and Uncertainty Analyses).

137. The ever-present threat of flooding in the Yazoo Backwater project area places farmers in a situation rendering them unable to optimally determine equipment, number of employees needed, or seasonal crop varieties, herbicides, fungicides, or insecticides, etc., requirements. Consequently, farmers in frequently flooded areas are severely limited in their ability to plan for and achieve the most efficient operation. These effects have been confirmed by field surveys and interviews with area farmers, landowners, and agricultural operators. Flooding conditions in the project area render this area highly responsive to flood-damage reduction. Reducing the flood threat would allow area farmers to more efficiently use their land (implement recommended practices, plant recommended crop varieties on optimum dates, etc.) and plan their operations.

138. Benefits from improved production levels on project area cleared lands are reflected in the increase in net productive values per acre harvested resulting from improved farming operations due to flood reductions provided by the project.

AGRICULTURAL CROPS

General

139. Flooding of agricultural cropland and poor drainage of agricultural lands plague the farming sector. For base (without-project) hydrologic conditions, approximately 630,000 total acres would be flooded in the area from a 100-year frequency flood event. This area includes 57 percent cleared acres flooded. Woodlands, much of which are publicly owned, encompass 37 percent of the flooded acres. This excludes the areas encompassed by catfish farming operations. Flooding of the project area is usually confined to the winter and spring months. Flooding may result from a single storm of a few days or a series of storms extending over several months.

140. Flood damages to agricultural crops are impacted by the time of year of flooding, duration of flooding, and frequency of flooding. Although frequent or intermittent floods occur any time of the year, flood records indicate that the majority of flooding occurs during the cropland preparation and spring planting months (January-June). Other flood events occur in the area during harvest (October-December). The average number of days flooded (duration of flooding) ranges from 8 to about 89 days. The longest duration occurred during the 1973 flood. Frequency of occurrence of flooding in the project area varies from 0.4 to 8.6 times annually based on historical flood records spanning a 55-year period from 1943-1997. Plates 4-26, 4-28, and 4-29 illustrate the areas inundated from several selected flood frequency events including the 1-, 10-, and 100-year. These delineations of flooding are presented for both base (without-project) and with-project (Plan 2) conditions.

141. Field surveys were conducted to obtain basic land use information for the project area to assess the extent of the flood problem to agricultural production. (A copy of the survey form is included as Attachment 7-D.) Interviews were conducted with county agricultural workers (county agents, NRCS, FSA, and Farmers Home Administration personnel). Data regarding existing average flood-free agricultural crop yields, estimated crop yields expected with-project implementation, distribution of crops, double-cropping information, trends of agricultural development, land clearing trends/activities, impacts on farm operations from farmed wetlands regulations and CRP trends, etc., were obtained for each reach in the project area. The personnel interviewed provided crop types, yield, distribution, and other data for the areas identified as being lower or frequently flooded areas and upper (higher elevation) areas of each reach.

142. With the field survey data collected and assimilated, office studies and analyses were conducted to review/compare field survey data with reported yield/distribution data for the two primary counties in which the project area is located (i.e., Yazoo Backwater reaches located either wholly or mostly within the two primary counties). These comparisons of yields/distributions were utilized to adjust field survey data as deemed appropriate.

143. In addition, the adjusted field survey data were reviewed and analyzed by agricultural research and experiment station personnel with the U.S. Department of Agriculture (USDA) and MSU (MAFES). With input received from this review/analysis, additional refinements were made to the field survey data regarding agricultural yields, crop distributions, and relationships of yields/distributions between the data for lower and upper levels by reach (Table 7-30). Additionally, minor adjustments were made following a review/analysis by personnel from the State of Mississippi, MAFES, and State Crop Reporting Service. The above analyses and reviews of the crop yield/distribution data provided valuable information as to the completeness, accuracy, acceptability, and reasonableness of the data. Table 7-30 presents estimated agricultural crop yields and distribution for Reach 1 for without- and with-project conditions.

Stratification

144. To more precisely address/evaluate flood damages to agricultural crops, each designated hydrologic reach was "stratified" (arranged or split) into an upper area or stratum and a lower stratum. This stratification establishes a "breakpoint," or elevation, which reflects that in the lower stratum, which is more flood-prone, crop-specific patterns or distributions exist which differ from those of the upper stratum. Field survey data, acreages flooded for various frequencies of flooding, and other information were utilized in the stratification process. A 2-year frequency elevation was determined to be appropriate for stratification purposes in the Yazoo Backwater area reformulation analysis. Average annual acreages flooded by lower and upper strata and by reach for without-project conditions are presented in Table 7-31. Table 7-32 presents the average annual acres flooded for with-project conditions. The cleared acres were adjusted to exclude farmed wetland acreages, lands that are part of the national wildlife refuges, and acreages of excessively flooded (very low elevation) cleared lands from the agricultural crop damage/benefit analyses.

TABLE 7-30
LAND USE AND FLOOD-FREE YIELDS a/
AGRICULTURAL CROPLAND AREA
BASE (WITHOUT-) AND WITH-PROJECT (PLAN 2) CONDITIONS
REACH 1
YAZOO BACKWATER AREA, MISSISSIPPI

Item	Base (Without-Project) Conditions		With-Project (Plan 2) Conditions	
	Crop Distribution a/ (%)	Flood-Free Yield	Crop Distribution a/b/ (%)	Flood-Free Yield
LOWER STRATUM				
Cotton	14.0	757.0 lb	18.0	828.0 lb
Rice	2.0	49.1 cwt	3.0	52.27 cwt
Grain Sorghum	2.0	67.1 bu	3.0	70.9 bu
Soybeans	61.0	20.4 bu	56.0	23.9 bu
Soybeans (DC)	16.0	16.4 bu	15.0	19.2 bu
Wheat (DC)	(16.0) c/	24.6 bu	(15.0) c/	29.3 bu
Miscellaneous	5.0	--	5.0	--
Total	100.0		100.0	
UPPER STRATUM				
Cotton	19.0	847.0 lb	20.0	898.0 lb
Rice	4.0	52.96 cwt	6.0	54.94 cwt
Grain Sorghum	3.0	90.0 bu	2.0	100.0 bu
Soybeans	47.0	26.2 bu	39.0	29.7 bu
Corn	17.0	156.9 bu	25.0	162.8 bu
Soybeans (DC)	4.0	21.0 bu	3.0	23.8 bu
Wheat (DC)	(4.0) c/	31.2 bu	(3.0) c/	34.6 bu
Miscellaneous	6.0	--	5.0	--
Total	100.0		100.0	

a/ Agricultural crop percentage distribution data reflect estimated land use (cropping patterns) for the agricultural cropland (cleared) sector, excluding catfish farm acreage, where appropriate.
b/ Applicable for all alternative plans considered in this reformulation study.
c/ Parentheses denote double-crop production.

TABLE 7-31
AVERAGE ANNUAL CLEARED ACRES FLOODED a/
LOWER AND UPPER AREAS (STRATA)
BASE (WITHOUT-PROJECT) CONDITIONS, BY REACH
YAZOO BACKWATER AREA, MISSISSIPPI
(acres)

Reach	Lower Stratum b/	Upper Stratum c/	Total Cleared
1	47.952	17.568	65.520
2	78,900	7,921	86,821
3	19,043	2,944	21,987
4	49,138	7,984	57,122
Total	195,053	36,417	231,450

a/ Source: Area-frequency analysis (adjusted).
b/ Average annual cleared acres flooded have been adjusted to exclude farmed wetland acreages, applicable refuge lands, and those excessively flooded (very low elevation) cleared acreages for use in the flood damage/benefit analyses for agricultural crops.
c/ Adjusted to exclude excessively flooded (very low elevation) cleared acreages, and excludes applicable refuge lands.

TABLE 7-32
AVERAGE ANNUAL CLEARED ACRES FLOODED a/
LOWER AND UPPER AREAS (STRATA)
WITH-PROJECT (PLAN 2) CONDITIONS, BY REACH
YAZOO BACKWATER AREA, MISSISSIPPI
(acres)

Reach	Lower Stratum b/	Upper Stratum c/	Total Cleared
1	25.065	2.044	27.109
2	47,619	810	48,429
3	19,054	355	12,495
4	33,664	643	34,307
Total	118,488	3,852	122,340

a/ Source: Area-frequency analysis (adjusted).
b/ Average annual cleared acres flooded have been adjusted to exclude farmed wetland acreages, applicable refuge lands, and those excessively flooded (very low elevation) cleared acreages for use in the flood damage/benefit analyses for agricultural crops.
c/ Adjusted to exclude excessively flooded (very low elevation) cleared acreages, and excludes applicable refuge lands.

145. Based on above finalized crop yield/distribution data and using 1994 agricultural crop budget data (costs/returns for achieving certain yield levels used as input to crop damage program and referred to as "Flood Damage Tables") provided by MSU (MAFES), net returns for applicable crops were determined for each reach, lower and upper areas, and for base (without-project) and with-project conditions. These data (yields, distribution, net returns, weighted net returns, etc., for applicable reaches, areas, and conditions) were prepared for use as input to an agricultural crop damage program to evaluate flood damages to crops. These computer program input data are referred to as "General Information for Crops."

Computerized Agricultural Crop Flood
Damage Assessment System (CACFDAS)

146. CACFDAS was developed by cooperative actions of the Department of Agricultural Economics of MSU, which is one of the major research components of MAFES, and the U.S. Army Corps of Engineers, Vicksburg District. Others involved in development of CACFDAS included specialists from USDA; Delta Branch Experiment Station, Stoneville, Mississippi; and the Mississippi Cooperative Extension Service, MSU. Participating scientists included agricultural agronomists, plant geneticists, plant pathologists, plant physiologists, soil and weed scientists, agricultural engineers, and agricultural economists.

147. CACFDAS calculates flood damages for each crop by analyzing daily flood-stage recorded data which reflect varying flood events (when cleared cropland is being flooded) or multiple flood events (analysis of multiple flood events of cleared cropland in the same year on the same area). The program allows for specific crop replanting and/or crop substitution.

148. CACFDAS was developed to include two general levels of management for the principal crops of rice, cotton, and soybeans--high management practices and typical management practices. In addition, a low management practice for soybeans was included for a late crop replanting alternative.

149. Budget data for high management practices include information on yields, production practices, and resource use rates provided by research scientists and extension specialists at experiment stations. Data reflect the potential for each crop for use with "best-known" or recommended practices.

150. Budgets reflecting typical management practices are based on information developed from a survey of cooperating farm producers in the Delta of Mississippi. Survey data were collected annually beginning in 1974 to provide information on production practices and performance rates of new equipment for the principal crops of cotton, soybeans, rice, wheat, corn, and grain sorghum. Typical management practices reflect current production practices and costs based on "usual input practices," the practices most commonly used by surveyed farm producers. Typical management crop budgets were used for the Yazoo Backwater flood damage/benefit analyses.

151. Calculation of agricultural crop flood damage is a complex process. The analytical program (CACFDAS) is structured to compute flood damages based on the time of the flood event as related to sequence of agricultural operations that have occurred in the crop production process. Duration factors, expressed as the number of days required to create damages, are developed for four stages of plant development from planting through harvest. These factors range from 1 to 10 days, depending on the crop and stage of plant development. Dates of normal planting, late planting, and last planting date are also developed by crop. These dates are important since they, in conjunction with the duration factors, are the base dates allowing flood damage, crop replanting, crop substitution, and crop yield reduction data to be derived.

152. Three components of information developed within the crop budgets are essential in assessing flood damages. These include production costs and harvesting equipment fixed costs; expected net returns to lands, management, and general farm overhead; and operation revenues

consisting of realized gross value of the harvested crop. These crop budget data (referred to as "Flood Damage Tables") are primary inputs to the flood-damage assessment program. Other important input items include crop distribution data, net and gross returns by crop, crop substitution data, etc., and hydrologic data containing "Daily Flood Duration Data," including date, elevation, and the number of cleared acres flooded for each daily stage.

Current Normalized Prices for Agricultural Crops

153. The gross returns for the analysis of the initial array of alternatives were calculated using FY 94 current normalized prices. This was the most recent set of crop prices available at the time this analysis was conducted. These prices were updated in subsequent evaluations. Use of current normalized prices is required by existing regulations and guidelines in evaluation of all water-related development projects. The method used to calculate current normalized prices (including the impacts of government support programs) utilizes information obtained from a structural econometrics model of the agricultural sector and input from commodity specialists in the Economic Research Service (USDA). The derivation of current normalized prices was approved by the Natural Resource and Environmental Committee. A comprehensive supply-demand analysis was used to minimize short-run distortions in prices from abnormal weather and temporary changes in the foreign demand for agricultural products. Expert analyses by commodity specialists derived consistent prices and indices for commodities not included in the structural model. Table 7-33 presents the FY 94 current normalized prices for this analysis for several of the major agricultural crops in the area.

TABLE 7-33
FY 94 CURRENT NORMALIZED PRICES
MAJOR AGRICULTURAL CROPS
YAZOO BACKWATER AREA, MISSISSIPPI

Crop	Amount ($)
Rice	7.26 cwt
Cotton (Lint and Seed)	0.65 lb
Soybeans	6.16 bu
Wheat	3.38 bu
Grain Sorghum	4.18 bu
Corn	2.63 bu

154. The increase in net productive value per acre harvested is calculated for each crop based on the differences in yield levels and crop distribution for without- and with-project conditions as presented in Tables 7-34 and 7-35. Extensive field investigations were conducted in the study area to determine without- and with-project flood-free land use and yield levels. Increases in yield levels and modifications in cropping practices are based on consultations with agricultural workers; interviews with county personnel, including county agents, NRCS, and FSA; and the input of experienced staff agronomists. The increase in net productive value per cleared acre harvested after installation of Plan 2 is $23.61 for the lower stratum of Reach 1 (Table 7-34), and $31.08 in the upper stratum (Table 7-35).

TABLE 7-34
WEIGHTED NET RETURNS PER ACRE HARVESTED AND INCREASE IN NET PRODUCTION VALUE PER ACRE HARVESTED
LOWER AREA (STRATA)
REACH 1, PLAN 2
(INITIAL ARRAY)
YAZOO BACKWATER AREA, MISSISSIPPI

Land Use	Price a/ ($)	Base (Without-Project) Conditions						With-Project Conditions						Increase in Net Productive Value/Acre
		Percent Distribution (%)	Average Yield/ Acre b/	Gross Value ($)	Production Cost ($)	Net Returns ($)	Weighted Net Returns ($)	Percent Distribution (%)	Average Yield/ Acre	Gross Value ($)	Production Cost ($)	Net Returns ($)	Weighted Net Returns ($)	
Cotton (Lint) (Seed)	(.65/lb) .569/lb 88.73/ton	14.0	757.0 lb	492.05	454.75	37.30	5.22	18.0	828.0 lb	538.20	466.06	72.14	12.99	7.77
Rice	7.26/cwt	2.0	49.1 cwt	356.47	371.18	-14.71	-0.29	3.0	52.27 cwt	379.48	376.04	3.44	0.10	0.39
Soybeans	6.16/bu	61.0	20.4 bu	125.66	111.91	13.75	8.39	56.0	23.9 bu	147.22	114.39	32.83	18.38	9.99
Double-cropping Soybeans Wheat	 6.16/bu 3.38/bu	 16.0 (16.0)	 16.4 bu 24.6 bu	 101.02 83.15	 81.90 80.58	 19.12 2.57	 3.06 0.41	 15.0 (15.0)	 19.2 bu 29.3 bu	 118.27 99.03	 83.66 82.83	 34.61 16.20	 5.19 2.43	 2.13 2.02
Grain Sorghum	4.18/bu	2.0	67.1 bu	280.48	187.37	93.11	1.86	3.0	70.9 bu	296.36	190.56	105.80	3.17	1.31
Miscellaneous and Idle	--	5.0	--	--	--	--	--	5.0	--	--	--	--	--	0
Total		100.0						100.0						
Net Productive Value Per Acre Harvested							18.65						42.26	23.61

a/ FY 94 current normalized prices.
b/ Average flood-free yields. This value allowed to vary by computer randomized number generator system from minus 5 percent to plus 5 percent as one aspect of the risk-based analysis procedure.

TABLE 7-35
WEIGHTED NET RETURNS PER ACRE HARVESTED AND INCREASE IN NET PRODUCTION VALUE PER ACRE HARVESTED
UPPER AREA (STRATA)
REACH 1, PLAN 2
(INITIAL ARRAY)
YAZOO BACKWATER AREA, MISSISSIPPI

Land Use	Price a/ ($)	Base (Without-Project) Conditions						With-Project Conditions						Increase in Net Productive Value/Acre
		Percent Distribution (%)	Average Yield/ Acre b/	Gross Value ($)	Production Cost ($)	Net Returns ($)	Weighted Net Returns ($)	Percent Distribution (%)	Average Yield/ Acre	Gross Value ($)	Production Cost ($)	Net Returns ($)	Weighted Net Returns ($)	
Cotton	(.65/lb)													
(Lint)	.569/lb	19.0	847.0 lb	550.55	469.08	81.47	15.48	20.0	898.0 lb	583.70	477.20	106.50	21.30	5.82
(Seed)	88.73/ton													
Rice	7.26/cwt	4.0	52.96 cwt	384.49	377.43	7.06	0.28	6.0	54.94 cwt	398.86	380.21	18.65	1.12	0.84
Soybeans	6.16/bu	47.0	26.2 bu	161.39	116.02	45.37	21.32	39.0	29.7 bu	182.95	118.50	64.45	25.14	3.82
Double-cropping														
Soybeans	6.16/bu	4.0	21.0 bu	129.36	84.80	44.56	1.78	3.0	23.8 bu	146.61	86.57	60.04	1.80	0.02
Wheat	3.38/bu	(4.0)	31.2 bu	105.46	83.73	21.73	0.87	(3.0)	34.6 bu	116.95	85.36	31.59	0.95	0.08
Corn	2.63/bu	17.0	156.9 bu	412.65	213.96	198.69	33.78	25.0	162.8 bu	428.16	215.65	212.51	53.13	19.35
Grain Sorghum	4.18/bu	3.0	90.0 bu	376.20	191.17	111.88	3.36	2.0	100.0 bu	418.00	192.27	225.73	4.51	1.15
Miscellaneous and Idle	--	6.0	--	--	--	--	--	5.0	--	--	--	--	--	--
Total		100.0						100.0						
Net Productive Value Per Acre Harvested							76.87						107.95	31.08

a/ FY 94 current normalized prices.
b/ Average flood-free yields. This value allowed to vary by computer randomized number generator system from minus 5 percent to plus 5 percent as one aspect of the risk-based analysis procedure.

155. A major input to the agricultural crop damage program is the hydrologic daily stage information spanning 55 years of record (1943-1997) for the Yazoo Backwater area. The daily stage hydrologic data, including date, associated stage or elevation of flooding, and number of cleared acres associated with each elevation of flooding, were prepared for base (without-project) and with-project (Plan 2) conditions for each reach and each alternative plan. The hydrologic data for each reach were then "split," applying the without-project conditions 2-year frequency flood elevation to form daily stage records for the lower and upper strata of each reach.

Summary, Agricultural Crop Damage, Current Year

156. Results from the agricultural crop damage program indicate that for without-project conditions, the estimated crop damages per acre for the lower stratum ranged from $29.14 per acre in Reach 1 to $43.10 per acre in Reach 2. Table 7-36 presents a summary of per-acre agricultural crop damages for without-project conditions. In the upper stratum, agricultural crop damages for without-project conditions ranged from $67.78 per acre in Reach 1 to $88.33 per acre in Reach 2. Without-project conditions crop damages for Reach 2, lower stratum, are estimated at $3,295,598 annually. This amount is derived by applying the crop-damage per-acre value for this area of $43.10 by the estimated number of average annual cleared acres flooded of 76,464 acres. Annual crop damages for other reaches/strata were similarly calculated. The estimated annual crop damage for the lower stratum, without-project conditions, for all reaches is estimated at $6.0 million (Table 7-37). For the upper stratum, the estimated annual agricultural crop damage is $2.4 million. Total current annual crop damages for without-project conditions, including both upper and lower areas of all reaches, are estimated at $8.4 million annually.

TABLE 7-36
SUMMARY, AGRICULTURAL CROP DAMAGES (PEAK ACRES FLOODED)
BASE (WITHOUT-PROJECT) CONDITIONS, BY PLAN BY REACH
YAZOO BACKWATER AREA, MISSISSIPPI

Reach	Lower Stratum ($) a/	Upper Stratum ($) b/
1	29.14	67.78
2	43.10	88.33
3	36.38	74.45
4	35.22	69.74

SOURCE: Output from CACFDAS. The per-acre crop damage from flooding is a combined damage value, reflecting or representing the cumulative damages sustained by each crop produced in the areas noted.

a/ Based on latest available "FY 94 Current Normalized Prices."

TABLE 7-37
SUMMARY, FLOOD DAMAGE TO AGRICULTURAL CROPS
BASE (WITHOUT-PROJECT) AND WITH-PROJECT (PLAN 2) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
($000) a/

Reach	Lower Stratum		Upper Stratum		Total	
	Base (Without-Project)	With-Project (Plan 2)	Base (Without-Project)	With-Project (Plan 2)	Base (Without-Project)	With-Project (Plan 2)
1	1,134	636	1,070	133	2,204	769
2	3,296	2,027	692	73	3,988	2,100
3	393	267	147	20	540	287
4	1,221	902	496	48	1,717	950
Total	6,044	3,832	2,405	274	8,449	4,106

a/ Numbers are rounded and therefore may not total to exact amounts presented in each column. Based on latest available "FY 94 Current Normalized Prices."

b/ Stage-area data have been refined several times throughout the analysis. Data utilized in this evaluation of the initial array of alternatives do not match data found in Table 7-3.

157. Agricultural crop damages for with-project conditions for the lower stratum ranged from $29.86 per acre for Reach 1, Plan 5, to $40.01 per acre for Reach 2, Plan 6. In the upper stratum, agricultural crop damages ranged from $58.41 per acre in Reach 4, Plan 5, to $95.25 per acre for Reach 2, Plan 1. Annual returns to agricultural crops for all reaches in the lower stratum with Plan 2 are estimated at $3.8 million (Table 7-37). Crop damages in the upper stratum for all reaches for with-project conditions are $274,000 annually. Total crop damages for with-project (Plan 2) conditions are $4.1 million annually.

Crop Damages, Projected

158. Potential exists in the project area agricultural sector for continued improvements in crop yields and/or overall increases in farm production levels. These increases in yields/production levels result from new and improved seed varieties, improved crop tillage methodologies, better management techniques, and/or various other new technologies which could emerge in the future. However, these technological benefits will be limited without implementation of the proposed water resources improvement project, which will reduce the threat of flooding. In order to reflect the impact of these crop yields/production levels, projection factors were employed to estimate crop damage for future time periods.

159. Projection factors for estimating future crop damage were based on results of a linear regression computer program. Without-project data for this evaluation included the values per harvested acre for selected years of reported agricultural crop sales data for the two primary counties in the economic base area. The U.S. Census of Agriculture data for agricultural crop sales and applicable number of harvested cropland acres are reported at 5-year intervals. These crop sales values were converted to a constant dollar basis for projection purposes. These values of farm product sales per harvested acre are reliable indicators of the historical increases in productivity for a specific area, and the extension of these trends into the future provides reasonable estimates of expected increases.

160. The reliability of the projected data values per harvested acre was tested for statistical significance. These data reflect statistical significance at the 5 percent level of probability with a coefficient of determination of 0.950. Historical and projected values of all farm products sold per harvested acre for selected years are presented in Table 7-38.

TABLE 7-38
HISTORICAL/PROJECTED VALUE OF AGRICULTURAL
CROP SALES PER HARVESTED ACRE a/
YAZOO BACKWATER AREA, MISSISSIPPI

Year	Value/Acre (1982 Dollars) ($)		Ratio of Increase (Over Prior Year) (%)
1969	177 a/		
		=	1.18079
1978	209 a/		
		=	1.06012
1982	221 a/		
		=	1.28826
1987	285 a/		
		=	1.09858
1996 b/	313 c/		
		=	1.15975
2006	363 c/		
		=	1.14050
2015	414 c/		
		=	1.12078
2025	464 c/		
		=	1.10776
2035	514 c/		
		=	1.09923
2045	565 c/		
		=	1.08850
2055	615 c/		

a/ Historical data based on Value of Agricultural Crop Sales, Yazoo Backwater area economic base area, by specific years, converted to 1982 constant dollars, divided by the applicable number of harvested cropland acres.

b/ Current year.

c/ Projected year. Analysis of other alternative plans involved different construction years, project completion dates, etc., used interpolated values from initial projected data.

161. The ratios of increase presented in Table 7-38 were used to project 1996 damages to agricultural crops to future time periods by 10-year increments (Table 7-39). Crop damages were projected and presented for without- project and with-project conditions (Plan 2 and other alternatives). For this analysis, the estimated project completion date for all plans of improvement is 2005. The first full year of project benefits (base year) is 2006. The 50-year period established as the expected economic life of the project is from 2006 to 2055. For base (without-project) conditions, annual crop damages in the project area for the current year (1996) are estimated at $8.4 million. With Plan 2, current-year crop damages would be reduced by 51 percent to an estimated $4.1 million annually.

TABLE 7-39
PROJECTED AGRICULTURAL CROP DAMAGES
BASE (WITHOUT-) AND WITH-PROJECT (PLAN 2) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
($000) a/

Year	Base (Without-Project) Conditions	With-Project (Plan 2) Plan Conditions
1996 (Current Year)	8,449	4,106
2006 (Base Year)	9,798	4,762
2015	11,175	5,431
2025	12,525	6,087
2035	13,874	6,743
2045	15,251	7,412
2055	16,601	8,068

a/ Based on latest available "FY 94 Current Normalized Prices."

AGRICULTURAL NONCROP

162. Flood damages to farm property other than crops include damages to farm supplies; farm roads; drainage ditches, including V and W types; fences; irrigation systems; and land forming and leveling.

163. Present agricultural noncrop damage values were determined by developing an appropriate noncrop damage factor per cleared-acre-flooded for each of the project area reaches. These noncrop damage factors were based on available noncrop survey data for this area and were updated applying appropriate cost index factors. This information was previously developed and compiled from a comprehensive study (in this area) conducted by a private consulting firm under contract to the Corps. The survey data extensively utilized aerial photographs, analysis of the amount of each damageable item, field investigations, updated normalized prices and costs, verified percent damage estimates, and appropriate flood analysis curves. The average annual damage-per-cleared-acre-flooded factor for each reach was multiplied by the average annual cleared acres flooded without- and with-project conditions for each respective reach to determine the present annual noncrop damages, as presented in Table 7-40.

TABLE 7-40
SUMMARY, FLOOD DAMAGES TO AGRICULTURAL NONCROP ITEMS
BASE (WITHOUT-PROJECT) AND WITH-PROJECT (PLAN 2) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 Values)
($000)

Reach	Base (Without-Project) Conditions	With-Project (Plan 2) Conditions
1	1.169	451
2	1,547	834
3	399	216
4	1,040	592
Total	4,155	2,093

164. Future damage values for noncrop items are based on projected values of all farm products sold per harvested acre (same projection indices used to determine future agricultural crop values). The projection factors used are presented in Table 7-38. Table 7-41 presents a summary of the estimated noncrop damages for projected time periods for the Yazoo Backwater area. Noncrop damages for without-project and for with-project (Plan 2) conditions are included. Annual noncrop damages in the project area would be reduced by 50 percent under with-project conditions.

TABLE 7-41
PROJECTED AGRICULTURAL FLOOD DAMAGES TO NONCROP ITEMS
BASE (WITHOUT-PROJECT) AND WITH-PROJECT (PLAN 2) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 Values)
($000)

Year	Base (Without-Project) Conditions	With-Project (Plan 2) Conditions
1996 (Current Year)	4,155	2,093
2006 (Base Year)	4,824	2,429
2015	5,426	2,733
2025	6,095	3,070
2035	6,764	3,407
2045	7,433	3,744
2055	8,102	4,081

CATFISH OPERATIONS

165. There are an estimated 33,300 acres of farm-raised catfish ponds in the Yazoo Backwater area. Based on a 5-year average price of $0.71 per pound and an output of 4,000 pounds per acre, the annual gross value of production of these ponds is $94 million. Two reaches within the

Yazoo Backwater area have significant flooding problems or damages to catfish farming operations. Flood-related damages to the catfish industry include revenue lost from escaped fish, reduced revenue due to shortened growing season, additional costs for restocking ponds after flooding, draining and refilling ponds, and from damages to pond levees, drainage systems, and water supply systems.

166. Damages to farm-raised catfish are calculated based on the historic flooding in each hydrologic reach where catfish production occurs. Acres of flooded ponds and depths of flooding on pond levees are based on recorded hydrologic data specific to certain points within the project area. Elevations for tops of levees were derived from satellite-generated photographs, quadrangle maps, and field observations. This procedure established damage elevations for all ponds in the project area.

167. Based on discussions with scientists at MSU, marketing of catfish occurs year-round; consequently, a large portion of the impacts from flooding is dependent on the time of year that flooding occurs. Losses from inundation were determined to be 50 percent of production in the first quarter, 25 percent in the second quarter, 100 percent in the third quarter, and 75 percent in the fourth quarter. These percentages were provided by MSU specialists who are recognized experts in the catfish industry. These impacts are based on 4,000 pounds of production per acre per year. According to MSU personnel, producers also keep an additional 1,700 pounds per-acre inventory of fish in ponds which would also be lost.

168. Any flooding in quarters 2 or 3 would also result in lost production time. There are approximately 183 days in a production year, since fish primarily feed and gain weight during high temperature months. Each day lost in the catfish growth cycle would result in 21.86 pounds per acre in lost production. This assumes that the average pond holds 4,000 pounds of fish per acre and that a constant linear growth rate exists throughout the growing season.

169. Costs for draining and refilling ponds were estimated to be $32.02 per acre. This value is based on a pond-filling time of 8.86 hours per acre reflecting approximately 3 days to drain and 7 days to refill for an average pond. Draining and refilling would create an additional 10 days lost production time. Restocking costs were estimated at $243.75 per acre (3,250 fingerlings at $0.075 each).

170. Due to lack of historical and empirical data and based on discussions with catfish producers and researchers, the assumption was made that inundation causes levee damages of 10 percent of initial levee construction cost per foot of levee height. This assumption was discussed with MSU/industry specialists to establish its reasonableness. Damages to levees are limited to perimeter levees. No damages are calculated for interior levees. Total length of exterior levees was determined by utilizing satellite photography. Initial levee construction is estimated at $9.14 per linear foot.

171. Additional losses occur from loss of access to ponds. Losses per acre associated with access problems would equate to loss of production time. As stated above, this is estimated at 21.86 pounds per acre per day. Due to the very high stocking rate of the commercial catfish operations, the fish must receive all nutritional requirements from the commercial feeds being fed on a daily basis. Therefore, when feedings are missed due to lack of access caused by high water, no weight gains are realized and a portion of the 183-day production period is lost. For this analysis, access is assumed to be blocked when floodwaters reach 3 feet in depth.

172. Annual damages were calculated for each reach by summing yearly damages for the appropriate flood history and dividing this total by the number of years in the flood history. In Reach 2, for example, annual damages for the existing hydrologic conditions were estimated to be $400,500. A similar analysis was conducted for each of the proposed alternatives using the appropriate with-project hydrologic data. Total annual damages for existing hydrologic

conditions are estimated to be $511,600 (Table 7-42). This compares to with-project damage estimates for Plan 2 of $149,700. Annual catfish benefits from implementation of Plan 2 are $361,900, and this value is held constant throughout the expected economic life of the project, primarily since the assumption is made that all future catfish ponds will be constructed to at least the 100-year frequency elevation. Also, the catfish farming industry is such a dynamic growth industry and highly dependent on demand that it is difficult to obtain or derive current reliable projection factors. Due to this and previously stated factors, the damage estimate for the catfish industry is possibly conservative and could be modified as additional information becomes available.

TABLE 7-42
SUMMARY OF ANNUAL FLOOD DAMAGES TO CATFISH FARMING OPERATIONS
BASE (WITHOUT-PROJECT) AND WITH-PROJECT (PLAN 2) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 Values)

Reach	Base (Without-Project) Conditions	With-Project (Plan 2) Conditions
1	0	0
2	400,500	149,700
3	0	0
4	111,100	0
Total	511,600	149,700

SUMMARY, FLOOD DAMAGES, BASE (WITHOUT-PROJECT) CONDITIONS

173. Total annual flood damages to present development within the Yazoo Backwater area are estimated at approximately $17,500,000 (Tables 7-43 and 7-44).

TABLE 7-43
PRESENT AND FUTURE NONAGRICULTURAL FLOOD DAMAGE VALUES, BASE (WITHOUT-PROJECT) AND WITH-PROJECT (PLAN 2) CONDITIONS a/
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 $ Values)
($000)

Item	Type of Damage													Total Flood Damage
	Nonagricultural									Agricultural				
	Residential, Commercial Buildings, Etc. b/		Emergency Costs c/		NFIP Operating Costs		Streets, Etc., Built-Up Areas	Public Roads and Bridges	Subtotal					
	Built-Up	Rural	Built-Up	Rural	Built-Up	Rural				Crops d/	Noncrop e/	Catfish Operations	Subtotal	
Present, 1996, Damage														
Without Project	110	1,962	7	163	4	29	138	1,918	4,345	8,449	4,155	512	13,116	17,461
With Project	10	271	f/	17	f/	6	62	1,123	1,490	4,106	2,093	150	6,349	7,839
Projected Base Year, 2006 Damage g/														
Without Project	110	1,962	7	163	4	29	138	1,927	4,354	9,798	4,824	512	15,134	19,488
With Project	10	271	f/	17	f/	6	62	1,129	1,496	4,767	2,429	150	7,346	8,842
Projected 2015 Damage														
Without Project	110	1,962	7	163	4	29	143	1,990	4,422	11,175	5,426	512	17,113	21,535
With Project	10	271	f/	17	f/	6	64	1,166	1,535	5,363	2,733	150	8,246	9,781
Projected 2025 Damage														
Without Project	110	1,962	7	163	4	29	147	2,042	4,478	12,525	6,095	512	19,132	23,610
With Project	10	271	f/	17	f/	6	66	1,196	1,567	6,024	3,070	150	9,244	10,811
Projected 2035 Damage														
Without Project	110	1,962	7	163	4	29	150	2,094	4,534	13,874	6,764	512	21,150	25,684
With Project	10	271	f/	17	f/	6	67	1,227	1,599	6,685	3,407	150	10,242	11,841
Projected 2045 Damage														
Without Project	110	1,962	7	163	4	29	152	2,123	4,565	15,251	7,433	512	23,196	27,761
With Project	10	271	f/	17	f/	6	68	1,244	1,617	7,346	3,744	150	11,240	12,857
Projected 2055 Damage														
Without Project	110	1,962	7	163	4	29	156	2,166	4,612	16,601	8,102	512	25,215	29,827
With Project	10	271	f/	17	f/	6	68	1,269	1,643	8,007	4,081	150	12,238	13,881

a/ Undiscounted values, rounded to nearest thousand.
b/ Includes damages to residences, commercial establishments, industrial buildings, professional properties, semipublic and public structures, and warehouses based on Risk-based analyses.
c/ Includes flood-fighting costs, evacuation costs, cleanup and debris removal costs, etc.
d/ Includes damages to all crops susceptible to flood damages. Inundation reduction benefits to crops cannot be determined by subtracting crop damages with project from crops damages without project as presented in Table 6-25.
e/ Includes damages to farm fences, drainage ditches, land leveling, land forming, farm roads, supplies, etc.
f/ Less than $1,000.
g/ Base year (first full year benefits will be realized after project completion).

TABLE 7-44
SUMMARY, FLOOD DAMAGES
BASE (WITHOUT-PROJECT) DAMAGES AND DAMAGES WITH
DETAILED ALTERNATIVE STRUCTURAL PLANS CONSIDERED
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 $ Values)
($000)

Flood Damage Category	Base (Without-Project) Conditions	Flood Damages with Alternative Plans ($000)					
		Plan 1 a/	Plan 2 b/	Plan 3 c/	Plan 4 d/	Plan 5 e/	Plan 6 f/
NONAGRICULTURAL							
Residences, Commercial Buildings, Etc.							
Built-Up	110	22	10	6	5	3	6
Rural	1,962	488	271	150	102	70	313
Emergency Costs							
Built-Up	7	1	g/	g/	g/	g/	g/
Rural	163	33	17	9	5	4	79
NFIP Operating Costs							
Built-Up	4	g/	g/	g/	g/	g/	g/
Rural	29	11	6	2	2	1	8
Streets, Etc.							
Built-Up	138	71	62	54	50	8	79
Public Roads and Bridges	1,918	1,249	1,123	1,052	996	942	1,499
Subtotal	4,345	1,878	1,490	1,273	1,160	1,028	1,985
AGRICULTURAL							
Crops	8,449	4,881	4,106	3,661	3,346	3,173	5,201

TABLE 7-44 (Cont)

Flood Damage Category	Base (Without-Project) Conditions	Flood Damages with Alternative Plans ($000)					
		Plan 1 a/	Plan 2 b/	Plan 3 c/	Plan 4 d/	Plan 5 e/	Plan 6 f/
Noncrop	4,155	2,400	2,093	1,915	1,810	1,739	2,710
Catfish Operations	512	174	150	108	69	44	186
Subtotal	13,116	7,455	6,349	5,684	5,225	4,956	8,097
TOTAL FLOOD DAMAGES	17,461	9,333	7,839	6,957	6,385	5,984	10,082
Percent Reduction in Flood Damages	--	47	55	60	63	66	42

a/ 10,500-cfs pumping plant facility.
b/ 14,000-cfs pumping plant facility.
c/ 17,500-cfs pumping plant facility.
d/ 21,000-cfs pumping plant facility.
e/ 24,500-cfs pumping plant facility.
f/ Big Sunflower River Levee (west side) alternative.
g/ Less than $1,000.

SECTION 6 - BENEFITS

GENERAL

174. The with-project benefits presented in this section reflect conditions with Plan 2. Benefits are based on the period of economic analysis; i.e., the period beginning with the estimated first full year of operation (base year) and continuing through the expected project economic life (2006-2055).

VALIDATION OF BENEFIT EVALUATION

175. In accordance with Principles and Guidelines (Policy and Planning Guidance for Conducting Civil Works Planning Studies, 28 December 1990, ER 1105-2-100), detailed project reports are encouraged to contain discussions summarizing any critical sensitivity analyses undertaken as part of plan formulation, evaluation, and selection. These analyses are used in examining the effects of varying assumptions and data relative to economic, hydrologic, and other elements which could determine the feasibility and recommendation of a project.

176. Sensitivity analyses, applied in the evaluation of structure (residences, commercial buildings, etc.) damages in the Yazoo Backwater area, included the application and testing of various hydrologic data at selected flood frequencies in determining the actual hydrologic conditions in the area. Other analyses include a comprehensive real estate assessment of each individual structure in the area which provided highly detailed data for each structure by specific location.

177. The level of agricultural production and agricultural price levels used in this study analyses were developed to eliminate the cyclical fluctuations characteristic of the agricultural industry.

Use of the sensitivity analyses would have necessitated consideration of varying production levels plus alternative assumptions on agricultural exports, allotment restrictions, etc. Since the project area is relatively small compared to the overall United States agricultural production areas, any alternative level of agricultural production would not significantly affect total United States agricultural production.

178. The benefit evaluations in this study were given additional credibility by the use of sensitivity analyses for structure damage assessment, sampling techniques, statistical testing, etc.

179. Built-up and rural residential damages were based on surveys of affected areas to determine number, type, and value of structures at selected elevations of flooding. Sampling techniques were applied to collect basic values used to determine damages to agricultural noncrop items and agricultural crops and roads and bridges.

BENEFIT CATEGORIES

180. The three major categories of benefits are inundation reduction, intensification, and employment benefits. Inundation reduction benefits consist of damage reduction to development expected to exist for present conditions and the reduction of damage to additional development without project installation. Intensification benefits result from additional potential created by the project, particularly in agriculture where opportunities for improvement are enhanced. Intensification benefits are measured in terms of increases in net returns to land on which cropping patterns change. Employment benefits are benefits derived from construction labor cost expenditures credited to the relief of unemployment and underemployment allocated to counties or parishes eligible for aid pursuant to the Economic Redevelopment Administration, U.S. Department of Commerce, as per current guidelines (Economic Guidance Memorandum 4-4, 22 March 1994).

BENEFITS BY SECTOR

181. Future flood control benefits were determined for nonagricultural and agricultural sectors affected by implementation of a water resources improvement project. Nonagricultural benefits within the project area consist of flood damage reduction to affected built-up and rural residences and other structures, automobiles, built-up area streets, roads and bridges, and reduction in emergency costs and NFIP operating costs. Agricultural benefits accruing to the project consist of flood damage reduction to agricultural crops, a variety of agricultural noncrop items, catfish farming, and increased net returns to land.

182. All benefits were discounted to determine present worth and were amortized over the expected project economic life to determine average annual values for each category. Benefits derived in the initial analysis are described herein. They are based on a 50-year development period, an expected project economic life of 50 years, and a current Federal discount rate of 7-5/8 percent.

INUNDATION REDUCTION BENEFITS

183. Inundation reduction benefits were evaluated for built-up and rural structures, emergency costs, NFIP operating costs, built-up area streets, roads and bridges, agricultural crops, agricultural noncrop items, and catfish farming.

BENEFITS TO BUILT-UP AREA AND RURAL AREA STRUCTURES

184. Benefits to built-up and rural structures in the project area from implementation of flood control measures considered are derived by subtracting remaining or with-project flood damages to structures from without-project flood damages to structures. Total flood damage reduction

benefits to built-up and rural structures vary from $1,562,000 for Alternative Plan 1 (10,500-cfs pump) to $1,999,000 for Alternative Plan 5 (24,500-cfs pump). Table 7-45 presents a summary of flood damage reduction benefits to structures for all alternative improvement plans considered in detail, and benefits for each alternative considered herein are summarized in Table 7-46.

TABLE 7-45
SUMMARY, ANNUAL BENEFITS FROM INUNDATION REDUCTION, STRUCTURES
INITIAL ARRAY OF ALTERNATIVES
RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
($000)

Item	Inundation Reduction Benefits to Structures a/				
	Reach 1	Reach 2	Reach 3	Reach 4	Total
Pumping Plant Alternatives					
Alternative Plan 1, 10,500 cfs	1,091	156	184	131	1,562
Alternative Plan 2, 14,000 cfs	1,252	177	213	149	1,791
Alternative Plan 3, 17,500 cfs	1,346	186	228	155	1,915
Alternative Plan 4, 21,000 cfs	1,384	188	236	157	1,965
Alternative Plan 5, 24,500 cfs	1,410	191	240	158	1,999
Levee Alternative					
Alternative Plan 6, Levee	1,321	193	153	86	1,753

a/ Output from Risk-based analyses based on initial 7-5/8 percent discount rate.

TABLE 7-46
ANNUAL BENEFITS FROM INUNDATION REDUCTION
BUILT-UP AND RURAL STRUCTURES, WITH PROJECT (PLAN 2)
RISK AND UNCERTAINTY ANALYSIS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 $ Values)
($000)

Year	Inundation Reduction Benefits to Residences, Commercial Buildings, Etc. a/		
	Built-Up Area	Rural Area	Total Area
1996 (Current Year) b/	100	1,691	1,791
2003 b/	100	1,691	1,791
2004	100	1,691	1,791
2005 b/c/	100	1,691	1,791
2006 (Base Year) d/	100	1,691	1,791
2015	100	1,691	1,791
2025	100	1,691	1,791
2035	100	1,691	1,791
2045	100	1,691	1,791
2055	100	1,691	1,791
Annual Benefits	100	1,691	1,791

a/ Output from Risk-based analyses based on initial 7-5/8 percent discount rate.
b/ Construction of with-project conditions (Plan 2) estimated to be initiated in year 2003.
c/ EPCD (year project construction completed).
d/ Base year of project or first full year in which project benefits occur.

PROJECT EFFECTIVENESS

Percent Reduction in Flood Damages to Structures

185. Effectiveness of alternative plans considered for possible implementation in the Yazoo Backwater area to alleviate or reduce existing flood damages to built-up or rural structures is

indicated by examining the percentage reduction in damages provided by each plan. The 14,000-cfs pumping plant alternative (Plan 2) would reduce existing flood damages to structures in the Yazoo Backwater area by 86 percent. Alternative Plan 1 (10,500-cfs pumping plant) would reduce existing flood damages to structures by 75 percent. Percentage reductions in existing flood damages provided by other plans considered vary from 85 percent for Alternative Plan 6 (levee plan) to 96 percent for Alternative Plan 5 (24,500-cfs pumping plant). Table 7-47 presents a summary of the percent reductions provided by each of the alternatives plans evaluated in detail.

TABLE 7-47
SUMMARY, PERCENT REDUCTION IN FLOOD DAMAGES TO STRUCTURES
INITIAL ARRAY OF ALTERNATIVES
RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
(%)

Item	Percentage Reduction in Flood Damages to Structures Provided by Alternative Plans Considered a/				
	Reach 1	Reach 2	Reach 3	Reach 4	Total
Pumping Plant Alternatives					
Alternative Plan 1, 10,500 cfs	74	80	74	81	75
Alternative Plan 2, 14,000 cfs	85	90	86	92	86
Alternative Plan 3, 17,500 cfs	92	95	92	96	92
Alternative Plan 4, 21,000 cfs	94	96	95	97	95
Alternative Plan 5, 24,500 cfs	96	97	96	98	96
Levee Alternative					
Alternative Plan 6, Levee	90	98	61	53	85

a/ Output from Risk-based analyses based on initial 7-5/8 percent discount rate.

REDUCTION OF EMERGENCY COSTS

186. Implementation of Plan 2 will reduce the various emergency-type costs associated with flooding (see Section 5 - Flood Damages). Benefits were derived by obtaining the difference in projected damage values (for without-project and with-project plan conditions (Plan 2)) and annualizing the projected benefit values. Table 7-48 presents a summary of the emergency cost reduction benefits for the project area. Benefits for the built-up areas are $7,000 annually. Reduction of emergency costs for the rural areas totals $146,000 annually.

TABLE 7-48
BENEFITS FROM REDUCTION IN EMERGENCY COSTS
WITH-PROJECT (PLAN 2)
YAZOO BACKWATER AREA, MISSISSIPPI
(7-5/8 Percent Discount Rate Analysis)
(1996 $ Values)

Year	Built-Up ($000)	Rural ($000)	Total ($000)
1996 (Current Year)	7	146	153
2006 (Base Year) a/	7	146	153
2015	7	146	153
2025	7	146	153
2035	7	146	153
2045	7	146	153
2055	7	146	153
Annual Benefits	7	146	153

a/ No benefits accrue to this alternative (Plan 2) prior to completion of project construction.

REDUCTION OF NATIONAL FLOOD INSURANCE
PROGRAM OPERATING COSTS

187. With implementation of Plan 2, the costs of administering flood insurance policies will be reduced (see Section 5 - Flood Damages). The operating cost per policy was $122 (the NFIP operating cost for FY 96). Flood damage reduction benefits can be derived by obtaining the

difference in the operating costs for without- and with-project conditions and annualizing the projected benefit values. For example, in the four built-up areas in the Yazoo Backwater area, approximately 29 residential and nonresidential structures which maintain flood insurance are subject to flooding by a 100-year frequency flood event for without-project conditions. With Plan 2, approximately 23 residential and nonresidential structures would be protected from flooding by a flood of this magnitude. The annual benefits from a reduction in NFIP operating costs, including built-up and rural sectors, would be $27,000 (Table 7-49). Fifteen percent ($4,000) of these benefits would accrue to the built-up areas, with the remaining 85 percent ($23,000) in the rural sectors.

TABLE 7-49
SUMMARY
REDUCTION IN NATIONAL FLOOD INSURANCE PROGRAM OPERATING COSTS
WITH-PROJECT (PLAN 2)
YAZOO BACKWATER AREA, MISSISSIPPI
(7-5/8 Percent Discount Rate Analysis)
(1996 $ Values)

Year	Built-Up ($000)	Rural ($000)	Total ($000)
1996 (Current Year)	4	23	27
2006(Base Year) a/	4	23	27
2015	4	23	27
2025	4	23	27
2035	4	23	27
2045	4	23	27
2055	4	23	27
Annual Benefits	4	23	27

a/ No benefits accrue to this alternative (Plan 2) prior to completion of project construction.

FLOOD DAMAGES PREVENTED TO
STREETS, ETC., BUILT-UP AREAS

188. The flood damages estimated to occur to streets in the four built-up areas are presented in Section 5 of this appendix. Flood damage reduction benefits to streets are derived by determining the difference in flood damages for base (without-project) conditions and the street damages remaining with implementation of Plan 2 and then annualizing the projected benefit values. Existing damage values were projected to increase over the expected economic life of the proposed flood control project. Average annual benefits of $77,000 would result from flood reduction to streets in built-up areas. Flood damage reduction benefits to streets are presented in Table 7-50.

TABLE 7-50
FLOOD DAMAGES PREVENTED TO STREETS, ETC., BUILT-UP AREAS
WITH-PROJECT (PLAN 2)
YAZOO BACKWATER AREA, MISSISSIPPI
(7-5/8 Percent Discount Rate Analysis)
(1996 $ Values)

Year	Total ($000)
1996 (Current Year)	76
2006 (Base Year) a/	76
2015	79
2025	81
2035	83
2045	84
2055	87
Annual Benefits	77

a/ No benefits accrue to this alternative (Plan 2) prior to completion of project construction.

PUBLIC ROADS AND BRIDGES

189. Benefits from flood damage reduction to public roads and bridges were determined by subtracting projected with-project damages from projected without-project damages (see Section 5 and annualizing the difference (values) over the project economic life. Existing values were projected to increase over the life of the project. Average annual benefits of $828,000 would result from reduction of flooding on public roads and bridges (Table 7-51).

TABLE 7-51
INUNDATION REDUCTION BENEFITS TO PUBLIC ROADS AND BRIDGES
WITH-PROJECT (PLAN 2)
YAZOO BACKWATER AREA, MISSISSIPPI
(7-5/8 Percent Discount Rate Analysis)
(1996 $ Values)

Year	Total ($000)
1996 (Current Year)	795
2006 (Base Year) a/	798
2015	824
2025	846
2035	867
2045	879
2055	897
Annual Benefits	828

a/ No benefits accrue to this alternative (Plan 2) prior to completion of project construction.

REDUCTION IN FLOOD DAMAGES
TO AGRICULTURAL CROPS

190. Flood damage reduction benefits to agricultural crops are based on an analysis of practices on lands not incurring changes in cropping patterns due to the project. Refer to the section

entitled "AGRICULTURAL CROP ANALYSES" for a detailed description of procedures employed in this study. That detailed process yielded the benefits for 1996 for each reach, strata, etc. Agricultural prices utilized in this portion of the study were Fiscal Year 1994 current normalized prices. This set of price values was the most current available at the time the analysis of the initial array of alternatives was conducted. Utilizing more recent crop prices would result in somewhat different benefit levels for each of the alternatives evaluated. The benefits for each of the alternatives would change proportionally; therefore, the differences between plans would not change. Since the analysis of the initial array of alternatives only serves as a screening to provide alternatives for subsequent evaluations, the decision was made not to revise these earlier evaluations to include the most current prices and costs levels that were used in the final array of alternatives.

191. The estimated net returns per acre harvested value is an important aspect in a farmer's decision-making process, since it is a quantifiable monetary function from which the farmer monitors his farming enterprise. In describing the computations contained in Table 7-52, it is important to realize that numerous factors impact the net returns value, and these values must be considered in the methodology to determine the final magnitude of inundation and intensification benefits resulting from installation of a water resources improvement project. Table 7-52 contains stepwise computations of agricultural crop benefits for Reach 1 for the initial array Plan 2. This computation reflects the change in overall net returns between the without- and with-project conditions. The computations are displayed for both the lower and upper strata and summarized to derive total crop benefits. This total is then segmented into inundation reduction and intensification components. The following discussion parallels the computations in Table 7-52.

TABLE 7-52
COMPUTATION OF INUNDATION REDUCTION AND
INTENSIFICATION BENEFITS a/ TO AGRICULTURAL CROPS BY STRATUM
BASE (WITHOUT-PROJECT) AND WITH-PROJECT CONDITIONS (PLAN 2)
REACH 1
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 $ Values)

CROPS	INUNDATION REDUCTION/INTENSIFICATION BENEFIT AMOUNT ($)			
1. LOWER STRATUM				
a. With-Project Conditions				
(1) Adj Net Returns Per Ac w/Proj ($42.26 - $18.65 * .477 + $18.65)	29.91			
(2) Ag Production Value w/Proj				
(a) Nonwetland Ac * Adj Net Returns per Ac w/Proj (18,365 * $29.91)		549,297		
(b) Wetland Ac * Net Returns per Ac (w/o Proj) (11,847 * $18.65)		220,947		
(c) Easement Ac * Net Returns per Ac (w/o Proj) (-- * $18.65)		0		
(d) Total Agricultural Production Value w/Proj		770,244	770,244	
(3) Flood Damage Remaining w/Proj (Avg Ann Cl Ac Flooded w/Proj * CACFDAS Adj Dam Per Ac w/Proj			(635,681)	
(4) Adj Net Production Value w/Proj			134,563	134,563
b. Without-Project Conditions				
(1) Ag Production Value wo/Proj (Cl Ac wo/Proj* Net Returns Per Ac wo/Proj) (30,212 * $18.65)			563,454	
(2) Flood Damage Remaining wo/Proj (Avg Ann Cl Ac Flooded wo/Proj * CACFDAS Dam Per Ac wo/Proj) (38,917 * $29.14)			(1,134,041)	
(3) Adj Net Production Value wo/Proj			-570,587	-570,587
c. Total Net Project Ag Crop Benefits (w/Proj - wo/Proj)				705,150
d. Intensification and Inundation Reduction (FDP) Benefit Classification				
(1) Intensified Crop Ac wo/Proj/Adj Cl Ac wo/Proj (1,516/30,212)	.05			
(2) Prorated Intensification Benefits wo/Proj		35,258		
(3) Prorated Inundation Reduction (FDP) Benefits wo/Proj		669,892		
e. Total Net Project (w/Proj - wo/Proj) Crop Benefits		705,150		

TABLE 7-52 (Cont)

CROPS	INUNDATION REDUCTION/INTENSIFICATION BENEFIT AMOUNT ($)			
2. UPPER STRATUM				
a. With-Project Conditions:				
(1) Adj Net Returns Per Ac w/Proj ($107.95 - $76.87 * .884 + $76.87)	104.34			
(2) Ag Production Value w/Proj (a) Wetland & Easement/Conserv Ac * Net Returns per Ac wo/Proj (0 * $76.87)		0		
(b) Total Cleared Ac wo/Proj * Adj Net Returns per Ac w/Proj (108,369 * $104.34)		11,307,221		
(c) Total Ag Production Value w/Proj		11,307,221	11,307,221	
(3) Flood Damage Remaining w/Proj (Avg Ann Cl Ac Flooded * CACFDAS Adj Dam per Ac w/Proj) (1,837 * $72.36)			(132,940.40)	
(4) Adj Net Production Value w/Proj			11,174,281	11,174,281
b. Without-Project Conditions:				
(1) Ag Production Value wo/Proj (Total Cl Ac wo/Proj * Net Returns per Ac wo/Proj) (108,369 * $76.87)			8,330,325	
(2) Flood Damage Remaining wo/Proj (Avg Ann Cl Ac Flooded * CACFDAS Dam per Ac wo/Proj) (15,789 * $67.78)			(1,070,178)	
(3) Adj Production Value wo/Proj			(7,260,147)	(7,260,147)
c. Total Net Project Ag Crop Benefits (w/Proj - wo/Proj)				3,914,134
d. Intensification and Inundation Reduction (FDP) Benefit Classification (1) Intensified Crop Ac wo/Proj/Adj Cl Ac wo/Proj (10,927/108,369)	.10			
(2) Prorated Intensification Benefits wo/Proj		391,413		
(3) Prorated Inundation Reduction (FDP) Benefits wo/Proj		3,522,721		
(4) Total Net Project (w/Proj - wo/Proj) Crop Benefits		3,914,134		
3. TOTAL PROJECT AGRICULTURAL BENEFITS				
a. Total Net Proj Ag Intensification Benefits				426,671
b. Total Net Proj Ag Inundation (FDP) Benefits				4,192,613
c. Total Net Proj Ag Inundation and Intensification Benefits for NED Project, Reach 1, 14,000-cfs Pumping Plant				4,619,284

a/ Flood damage remaining values included to display, clarify, and adjust computation of benefits, where appropriate.
b/ 14,000-cfs pumping plant with 80-foot operation stage at Steele Bayou.

192. Computations for the lower stratum (stratified at the 2-year frequency event) reflect an adjusted net returns per acre value of $29.91 for with-project conditions. This value results from subtracting per-acre without-project conditions net returns from with-project conditions net returns, multiplied by an adjustment factor of 0.477 to account for the project degree of protection, then adding without-project expected net returns per acre for an adjusted net returns per acre value (Table 7-52; Item 1.a.(1)). This value was applied to impacted acres in determining the unadjusted agricultural production value of $549,297 (Item 1.a.(2)(a)). Applicable farmed wetland acreage was then adjusted (as appropriate) in Item 1.a.(2)(b) to exclude CRP and WRP acreage (analysis indicated the amount of CRP and WRP lands as well as farmed wetlands) and multiplied by the without-project conditions expected net returns per acre value. This adjustment is necessary since wetland acreage benefits can be claimed only from without-project conditions expected net returns value, since additional land improvements are restricted by new and/or current regulations governing activities on these types of areas. The next step in the process was to remove flood damages from the total agricultural production value of $770,244 ($549,297 + $220,947). This entails multiplying the adjusted (deletes farmed wetland acreage, public lands, and low-lying cleared acres) average annual with-project cleared acres by the average annual damage value per peak acre flooded computed by CACFDAS (see explanation of this program in previous discussion) computer program (20,342 acres x $31.25 = $635,681). Results of the above computations, as presented in Item 1.a.(4), indicate a lower stratum with-project adjusted production value of $134,563 ($770,244 - $635,681).

193. Without-project conditions computation was made to determine the value of crop production for without-project conditions; i.e., should no water resources improvement project be constructed. Items 1.b.(1) and 1.b.(2) of Table 7-52 compute the agricultural production and flood damage remaining values, respectively. The total lower stratum adjusted cleared acreage (30,212) is multiplied by the without-project lower stratum weighted net returns per acre value ($18.65, from Table 7-34) to obtain the agricultural production value of $563,454 (30,212 acres x $18.65 per acre). The flood damage remaining value was determined by multiplying lower

stratum adjusted average annual without-project cleared acreage by the damage value per peak cleared acre flooded as computed by CACFDAS. The procedure yielded a value of $1,134,041 (38,917 acres x $29.14 per acre). This value was then subtracted from the without-project agricultural production value of $563,454 which resulted in a lower stratum without-project total benefit value of $-570,587 ($563,454 - $1,134,041). This value was subsequently subtracted from the with-project value to obtain the net benefit value of $705,150 ($134,563 - $-570,587). In Item 1.d., the portion of the net benefit value of $705,150 associated with intensification was determined to be 5 percent (1,516 acres ÷ 30,212 acres) The benefits for intensification were computed to be $35,258 ($705,150 x .05). Benefits for inundation reduction for the lower stratum are $669,892 ($705,150 - $35,258).

194. Upper stratum analyses are determined utilizing the same procedure explained above for the lower stratum (see Table 7-52), except no wetlands exist in the upper stratum; consequently, no acreage and net returns adjustments were made in Item 2.a.(2)(a). Upper stratum net project total benefits were determined to be $3,914,134. Intensification benefits were determined to be $391,413 for Reach 1 upper stratum. Total agricultural project crop benefits are $3,914,134.

195. Total project area agricultural crop benefits for with-project conditions (Plan 2), Reach 1, were determined to be $4,619,284 ($705,150 from the lower stratum plus $3,914,134 from the upper stratum). Total intensification benefits are $35,258 (lower stratum) and $391,413 from the upper stratum (see Table 7-52). Total area agricultural crop inundation reduction benefits are $4,192,613 ($669,892 from the lower stratum plus $3,522,721 from the upper stratum). Total base year agricultural inundation benefits for the initial array Plan 2 are $9,794,000 (Table 7-53).

TABLE 7-53
INUNDATION REDUCTION BENEFITS TO AGRICULTURAL CROPS
WITH-PROJECT (PLAN 2)
YAZOO BACKWATER AREA, MISSISSIPPI
(7-5/8 Percent Discount Rate Analysis)
(1996 $ Values)

Year	Total ($000)
1996 (Current Year)	9,794
2006 (Base Year) a/	11,359
2015	12,955
2025	14,520
2035	16,085
2045	17,680
2055	19,245
Annual Benefits	13,340

a/ No benefits accrue to this alternative (Plan 2) prior to completion of project construction.

196. Computations indicate that the base year (2006) flood damage reduction benefits to crops would be $11.4 million. Total average annual inundation reduction benefits to crops would be $13.3 million. Discounting of agricultural crop benefits was accomplished utilizing the computer discounting program ECON.

INTENSIFICATION BENEFITS, AGRICULTURAL CROPS

197. Intensification benefits to agricultural crops are based on an analysis of practices on lands incurring changes in cropping patterns due to the project resulting from shifts to crops accruing greater cash (net returns) value. Refer to section entitled "AGRICULTURAL CROP ANALYSES" for a detailed description of procedures used in determining intensification benefits for the current year (1996). Intensification benefits to agricultural crops were projected to future time periods using the same projection values used to project values for inundation benefits to crops. Present and future benefits are summarized in Table 7-54.

198. Computations indicate that the base year (2006) intensification benefits to agricultural crops would be $141,000 at the current discount rate. Benefits from intensification to crops would be $191,000 annually. Intensification benefits are minor in magnitude when compared to the potential increases in without-project crop damages. Should future computations suggest otherwise, adjustments will be made accordingly. These intensification benefits are included in the agricultural crop benefits shown in Table 7-54.

TABLE 7-54
INTENSIFICATION BENEFITS, AGRICULTURAL CROPS
WITH-PROJECT (PLAN 2)
YAZOO BACKWATER AREA, MISSISSIPPI
(7-5/8 Percent Discount Rate Analysis)
(1996 $ Values)

Year	Total ($000)
1996 (Current Year)	141
2006 (Base Year) a/	164
2015	184
2025	207
2035	229
2045	252
2055	275
Annual Benefits	191

a/ No benefits accrue to this alternative (Plan 2) prior to completion of project construction.

AGRICULTURAL NONCROP ITEMS

199. Benefits from flood damage reduction to agricultural noncrop items were determined by deriving the difference between projected base (without-project) flood damage values and projected with-project (Plan 2) damage values and annualizing the projected benefit values (see Section 5). Total average annual benefits to agricultural noncrop items of $2,796,000 would accrue to the project area (Table 7-55).

TABLE 7-55
INUNDATION REDUCTION BENEFITS TO AGRICULTURAL NONCROP ITEMS
WITH-PROJECT (PLAN 2)
YAZOO BACKWATER AREA, MISSISSIPPI
(7-5/8 Percent Discount Rate Analysis)
(1996 $ Values)

Year	Total ($000)
1996 (Current Year)	2,062
2006 (Base Year) a/	2,395
2015	2,693
2025	3,025
2035	3,357
2045	3,689
2055	4,021
Annual Benefits	2,796

a/ No benefits accrue to this alternative (Plan 2) prior to completion of project construction.

REDUCTION IN FLOOD DAMAGES TO
CATFISH FARMING OPERATIONS

200. With implementation of Plan 2 in the Yazoo Backwater area, catfish farm operations will be benefited to the extent that flood damages to these activities will be reduced. Flood damages to catfish operations are discussed in Section 5 - Flood Damages. Benefits were derived by obtaining the difference in projected damage values (for without-project and with-project (Plan 2) conditions) and annualizing the projected benefit values. Table 7-56 provides a summary of benefits to catfish farm operations. Total benefits are $362,000 annually.

TABLE 7-56
BENEFITS FROM FLOOD DAMAGES PREVENTED TO CATFISH OPERATIONS
WITH-PROJECT (PLAN 2)
YAZOO BACKWATER AREA, MISSISSIPPI
(7-5/8 Percent Discount Rate Analysis)
(1996 $ Values)

Year	Total ($000)
1996 (Current Year)	362
2006 (Base Year) a/	362
2015	362
2025	362
2035	362
2045	362
2055	362
Annual Benefits	362

a/ No benefits accrue to this alternative (Plan 2) prior to completion of project construction.

EMPLOYMENT BENEFITS

201. Construction of Plan 2 within the study area will result in the creation of additional NED benefits to the project from employment of previously unemployed/underemployed labor resources in the area, thereby directly reducing unemployment and underemployment in the construction industry in this area. Also, project construction can contribute to an increase in the income of persons in associated industries (manufacturing, retail and wholesale trade, etc.), which will be increased indirectly due to the interrelationship and interdependence of these industries. Current economic evaluation guidance indicates that both counties are areas eligible for this type of benefit since these counties have been identified as experiencing "substantial and persistent unemployment." The criteria for identification of these areas are contained in NED Benefit Evaluation Procedures, Section XI of the Water Resources Council's Economic and Environmental Guidelines for Water and Related Land Resources Implementation Studies. These criteria were formerly used by the Economic Development Administration in designating qualified areas under Subsection 1 of Title IV of the Public Works and Economic Development Act of

1965 (Public Law 89-136, as amended). These criteria state that substantial and persistent unemployment exist in an area when:

a. The current rate of unemployment, as determined by appropriate annual statistics for the most recent 12 consecutive months, is 6 percent or more and has averaged at least 6 percent for the qualifying time periods specified in paragraph b.

b. The annual average rate of unemployment has been at least (1) 50 percent above the national average for 3 of the preceding 4 calendar years, (2) 75 percent above the national average for 2 of the preceding 3 calendar years, or (3) 100 percent above the national average for 1 of the preceding 2 calendar years. The determinations of substantial and persistent unemployment were based on the following national unemployment rates for the relevant time periods provided by the Bureau of Labor Statistics (1987, 27.9 percent; 1988, 19.7 percent; 1989, 16.38 percent; and 1990, 14.5 percent.

202. Table 7-57 is presented as an example of the procedure for calculation of employment benefits with construction of Plan 2. This same procedure was used for evaluation of employment benefits for all of the alternative plans evaluated. As presented in Table 7-57, Step 1, the first cost for construction of Alternative Plan 2 is $112,503,758. This cost excludes costs for lands, easements, rights-of-way, rehabilitation, and damages, engineering and design costs, and costs of construction management. In Step 1 of the calculation, the costs are allocated by construction year (2003-2005, 3 years). In Step 2, the costs are adjusted to reflect present-worth values which convert costs during the construction period to present values. Costs are presented for the 7-5/8 percent discount rate. Step 3 allocates the amount of the present-worth costs which is estimated to be expended for labor. For this plan, 40 percent of the construction cost is estimated to be the costs for construction labor. In Step 4, the estimated onsite construction labor cost is allocated by skill level. In Step 5, the onsite labor costs by skill level are adjusted to reflect the amount applicable as a benefit to the unemployed/underemployed area labor resources. In Step 6, these employment benefits are annualized for the 50-year expected economic life, resulting in an

estimated employment benefit of $1,335,000 annually. It must be noted that, although employment benefits are identified as valid NED benefits, they cannot and were not used in this report in the project reformulation, project sizing, or NED plan determination/selection. However, they are included in the presentation of a final benefit-cost analysis, as per current regulations and guidelines. Table 7-58 presents employment benefits for all of the detailed structural alternative plans considered.

TABLE 7-57
EMPLOYMENT BENEFITS
WITH PLAN 2
YAZOO BACKWATER AREA, MISSISSIPPI
(7-5/8 Percent Discount Rate Analysis)

1. ESTIMATED CONSTRUCTION EXPENDITURES a/: = $112,503,758

Year	Percent	Construction Expenditures ($000)
2003	.25	28,125,940
2004	.40	45,001,503
2005	.35	39,376,315
Total	100	112,503,758

2. PRESENT WORTH VALUE, CONSTRUCTION COSTS:

Year	Factors	Present Worth Values ($000)
2003	1.20166	33,798
2004	1.11653	50,246
2005	1.03742	40,850
Total		124,894

TABLE 7-57 (Cont)

3. ESTIMATED ONSITE CONSTRUCTION LABOR COSTS ($000):

(Use 40 Percent) b/	$49,957

ALLOCATION OF ONSITE CONSTRUCTION LABOR COST BY SKILL LEVEL:

Skill Level	Percent b/	Amount ($000)
Skilled	60	29,974
Unskilled	30	14,987
Other	10	4,996
Total		49,957

5. ALLOCATION TO UNEMPLOYED/UNDEREMPLOYED RESOURCES:

Skill Level	Percent b/	Amount ($000)
Skilled	30	8,992
Unskilled	47	7,044
Other	35	1,749
Total		17,785

6. ANNUAL BENEFIT VALUE ($000): = $1,335 d/

a/ December 1994 price levels. Construction costs exclude costs for engineering and design, construction management, and lands and damages, except for $4,538,758 for land acquisition and mitigation costs.
b/ Based on similar work in region. Obtained from Design Branch, Cost Engineering Section.
c/ As prescribed by Section XI, ER 1105-2-100 (28 Dec 90), page 6-127.
d/ Annualized with use of 7-5/8 percent discount rate and an estimated 50-year project economic life.

TABLE 7-58
SUMMARY
EMPLOYMENT BENEFITS a/
ALL DETAILED STRUCTURAL ALTERNATIVE PLANS
YAZOO BACKWATER AREA, MISSISSIPPI
(7-5/8 Percent Discount Rate Analysis)

Alternative	Employment Benefits ($)
Plan 1	902,307
Plan 2	1,335,000
Plan 3	1,361,121
Plan 4	1,566,915
Plan 5	1,742,825
Plan 6	975,305

a/ Does not include mitigation costs in the computation of employment benefits, does include all other construction costs.

TOTAL BENEFITS

203. Table 7-59 presents the total benefits for each of the alternatives evaluated. Total benefits ranged from $16.6 million for Plan 1, the 10,500-cfs pump, to $22.7 million for Plan 5, the 24,500-cfs pump. Benefits for Plan 2, the 14,000-cfs pump, totaled $19.5 million for the Yazoo Backwater area.

SUMMARY, TOTAL BENEFITS

204. Total average annual benefits for Plan 2 were determined to be $19,373,000, excluding employment benefits (see Table 7-60). Total average annual benefits for Plan 2, including employment benefits are determined to be $20,708,000. The above values are also based on a 50-year growth period and an expected project economic life of 50 years. Tables 7-60 and 7-61 present annual benefits for the Yazoo Backwater area.

TABLE 7-59
BENEFITS FOR STRUCTURAL ALTERNATIVES
INITIAL ARRAY OF ALTERNATIVES
YAZOO BACKWATER REFORMULATION STUDY
(7-5/8 Percent Discount Rate Analysis)
(1996 $ Values)
($000)

Benefits	Pumping Station					Alternative Plan 6
	Alternative Plan 1	Alternative Plan 2	Alternative Plan 3	Alternative Plan 4	Alternative Plan 5	
	10,500-cfs	14,000-cfs	17,500-cfs	21,000-cfs	24,500-cfs	Levee
Structures	1,560	1,791	1,920	1,970	2,000	1,750
Emergency Costs	135	152	161	164	166	90
NFIP Operating Costs	21	27	30	31	32	25
Streets, Etc.	68	77	85	89	92	60
Public Roads and Bridges	697	828	902	950	985	436
Agricultural Crops	11,400	13,340	14,600	15,300	15,700	10,400
Agricultural Noncrop	2,380	2,796	3,040	3,180	3,280	2,000
Catfish Operations	337	362	404	442	467	325
Total	16,600	19,373	21,100	22,100	22,700	15,100

a/ Rounded.

TABLE 7-60
SUMMARY, PROJECTED AND ANNUAL BENEFITS
WITH ALTERNATIVE PLAN 2
YAZOO BACKWATER AREA, MISSISSIPPI
(7-5/8 Percent Discount Rate Analysis)
($000)

Year	Benefit Categories															
	Inundation Reduction												Intensification			
	Residences, Commercial Buildings, Etc.		Emergency Costs		NFIP Operating Cost		Streets, Built-up Areas	Public Roads and Bridges	Ag. Crops d/	Ag. Noncrops	Ag. Catfish Operations	Subtotal	Ag. Crops	Subtotal	Employ Benefits a/	Total
	Built-up	Rural	Built-up	Rural	Built-up	Rural										
1996 a/b/	100	1,691	7	146	4	23	76	795	9,794	2,062	362	15,060	141	15,201	1,335	16,536
2006 c/	100	1,691	7	146	4	23	76	798	11,359	2,395	362	16,961	164	17,125	1,335	18,460
2015	100	1,691	7	146	4	23	79	824	12,955	2,693	362	18,884	184	19,068	1,335	20,403
2025	100	1,691	7	146	4	23	81	846	14,520	3,025	362	20,805	207	21,012	1,335	22,347
2035	100	1,691	7	146	4	23	83	867	16,085	3,357	362	22,725	229	22,954	1,335	24,289
2045	100	1,691	7	146	4	23	84	879	17,680	3,689	362	25,458	252	25,710	1,335	27,045
2055	100	1,691	7	146	4	23	87	897	19,245	4,021	362	27,396	275	27,671	1,335	29,006
Annual Benefits	100	1,691	7	146	4	23	77	827	13,149	2,796	362	19,182	191	19,373	1,335	20,708

a/ Includes cost value for mitigation.
b/ Current year. No benefits estimated to accrue to impacted area prior to completion of construction of the NED plan of improvement.
c/ Base year of project; first full year of project operation--first year in which full benefits to project accrue.
d/ Agricultural crop annual benefits in this column do not include intensification benefits.

TABLE 7-61
SUMMARY, ANNUAL BENEFITS
INITIAL ARRAY OF ALTERNATIVES
(7-5/8 Percent Discount Rate Analysis)
($000)

Item	Alternative Structural Plans					
	1 a/	2	3	4	5	6 b/
INUNDATION REDUCTION						
Nonagricultural						
Structures						
Built-up	88	99	104	105	106	104
Rural	1,474	1,692	1,813	1,861	1,893	1,649
Emergency Costs						
Built-up	6	6	6	6	7	6
Rural	129	146	154	158	159	84
Flood Insurance						
Program Operating Costs						
Built-up	3	3	4	4	4	3
Rural	18	24	27	28	28	21
Streets, Built-up	68	77	85	89	92	60
Public Roads and Bridges	697	828	902	950	985	436
Subtotal	2,483	2,875	3,095	3,201	3,274	2,363
Agricultural						
Crops	11,270	13,149	14,401	15,069	15,440	10,273
Noncrop	2,379	2,796	3,036	3,178	3,275	1,999
Catfish Operations	337	362	403	442	467	325
Subtotal	13,986	16,307	17,840	18,689	19,182	12,597
Subtotal, Inundation Reduction	16,469	19,182	20,935	21,890	22,456	14,960
INTENSIFICATION						
Agricultural Crops	163	191	209	220	226	128
TOTAL FLOOD CONTROL	16,632	19,373	21,144	22,110	22,602	15,101
EMPLOYMENT c/	1,088	1,335	1,598	1,841	2,058	995
TOTAL BENEFITS	17,720	20,708	22,742	23,951	24,740	16,083

a/ Alternative Plans 1-5 are pumping plant facilities including 3,500-cfs increments from 10,500 to 24,500-cfs pumping capacities.
b/ Alternative Plan 6 includes a levee on the west side of Big Sunflower River.
c/ Includes mitigation cost value.

SECTION 7 - COSTS

COSTS (ALL DETAILED STRUCTURAL ALTERNATIVE PLANS)

FIRST COSTS

205. Construction first costs for the initial alternative structural plans evaluated in detail are presented in Table 7-62 to facilitate the plan evaluation/selection process. Estimated total first costs for the various plans range from $109.5 million for Plan 1 to $199.7 million for Plan 5. All first costs are Federal costs with no non-Federal costs required for project construction. First costs are based on January 1997 price levels with a contingency allowance of 25 percent included in the estimates. Engineering and design and construction management costs are estimated using a percentage based on costs of similar projects throughout the United States. Detailed cost information is contained in Appendix 6.

ANNUAL COSTS

206. Annual costs for all alternative plans are summarized in Table 7-63. Estimates of annual costs associated with construction of structural plans evaluated in detail were based on an expected project economic life of 50 years and applying the current Federal discount rate. Interest and sinking fund costs reflect the estimated amortization costs. Costs for interest during construction, which account for the cost of capital incurred during the construction period, are included in total investment costs. The estimated cost of operation and maintenance is based on previous annual cost expenditures for similar work for this region. Annual rehabilitation costs are also included. Pumping plant replacement costs are estimated to be required every 35 years

TABLE 7-62
FIRST COSTS BY MAJOR FEATURE
INITIAL ARRAY OF ALTERNATIVES a/
YAZOO BACKWATER AREA, MISSISSIPPI
($000)

Item	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6
Lands and Damages	--	--	--	--	--	23,488
Relocations	--	--	--	--	--	821
Pumping Plant (Electric)	68,369	84,462	104,898	121,276	135,238	--
Levee and Floodwalls	741	741	741	741	741	41,136
Channels and Canals	2,697	2,983	3,268	3,531	3,794	--
Floodway Control and Diversion Structures	--	--	--	--	--	20,765
Building, Grounds, and Utilities	656	656	656	656	656	--
Permanent Operating Equipment	500	500	500	500	500	--
Mitigation	14,990	18,624	19,132	22,181	25,469	10,314
Planning, Engineering, and Design	12,753	13,496	15,245	17,122	18,304	15,265
Construction Management	8,795	9,717	11,628	13,400	14,976	6,573
Total	109,501	131,178	156,068	179,407	199,677	118,362

a/ Costs reflect January 1997 price levels.

TABLE 7-63
FIRST COSTS AND ANNUAL COSTS
INITIAL ARRAY OF ALTERNATIVES
YAZOO BACKWATER AREA, MISSISSIPPI
(7-5/8 Percent Discount Rate Analysis)
($000)

Item	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6
First Costs a/						
First Cost	109,501	131,178	156,068	179,407	199,677	118,362
Interest During Construction b/	12,059	14,446	17,187	19,757	21,089	26,068
Total Investment	121,560	145,623	173,255	199,163	221,666	144,431
Annual Costs c/						
Interest and Sinking Fund	9,510	11,392	13,554	15,581	17,341	11,299
Operation and Maintenance	--	--	--	--	--	--
Mitigation Maintenance	235	292	300	347	399	129
Pump Maintenance	708	752	791	827	859	152
Pump Operation (Energy)	1,079	1,486	2,053	2,324	2,542	--
Major Rehabilitation, Pumps	101	135	169	202	236	--
Fish and Wildlife Losses	c/	c/	c/	c/	c/	c/
Total Annual Costs	11,633	14,057	16,866	19,281	21,377	11,580

a/ January 1997 price levels.

b/ Based on use of estimated construction schedule of expenditures for each plan and appropriate interest and discount rate. Estimated construction period for Plans 1-5 is 3 years and construction period for Plan 6 is 6 years.

c/ Fish and wildlife losses are incorporated in mitigation analyses.

during the expected economic life of each alternative plan. Pump rehabilitation costs occur the same year for each alternative plan. Project-related fish and wildlife losses are not included in the annual costs, but are included in the assessment of net values (gains and losses) in the associated mitigation analysis (Appendix 1).

SECTION 8 - ECONOMIC JUSTIFICATION

ECONOMIC ANALYSIS (STANDARD)

SELECTION OF STRUCTURAL COMPONENT

General

207. Selection of the alternative plan which maximizes net benefits (plan with greatest amount of excess benefits over costs) accomplishes the current guidance for addressing the NED plan of improvement. Data at the current Federal discount rate of 7-5/8 percent were used to select the optimum plan, the plan with the greatest net benefits, from select structural alternatives evaluated in the initial array.

NED Plan

208. Table 7-64 summarizes the results of the reformulation/evaluation analyses for Alternative Plans 1-6. Table 7-64 presents a summary of summary of economic analyses--costs, benefits, benefit-cost ratios, etc. Based on existing criteria, the NED plan, the plan with the greatest excess-benefits-over-costs value (excluding employment benefits, but including costs for mitigation) was selected as the plan to proceed into the next phase of evaluation. First costs for Plan 2 are estimated at $131.2 million with annual costs of $14,057,000 including costs for mitigation and annual benefits of $19,373,000 excluding employment benefits ($20,708,000 including employment benefits). The excess benefits over costs for Plan 2 are $5,316,000 and the benefit-cost ratio is 1.4 excluding employment benefits. The excess benefits over costs are $6,651,000 including employment benefits with a benefit-cost ratio of 1.5 for Plan 2.

TABLE 7-64
SUMMARY, ECONOMIC ANALYSIS
FIRST COSTS, ANNUAL COSTS, ANNUAL BENEFITS,
EXCESS BENEFITS OVER COSTS, AND BENEFIT-COST RATIOS
INITIAL ARRAY OF ALTERNATIVES
YAZOO BACKWATER AREA, MISSISSIPPI
(7-5/8 Percent Discount Rate Analysis)
(Standard Analysis)

Item	Detailed Alternative Structural Plans Evaluated					
	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6
First Costs ($000) b/	109,501	131,178	156,068	179,407	199,677	118,362
Annual Costs ($000) a/b/	11,633	14,057	16,866	19,281	21,377	11,580
Annual Benefits ($000) b/						
All Benefit Categories b/	17,720	20,708	22,742	23,951	24,740	16,083
Benefits Excluding Employment Benefits	16,632	19,373	21,144	22,110	22,682	14,960
Excess Benefits Over Costs ($000)						
All Benefit Categories b/	6,087	6,651	5,876	4,670	3,363	4,503
Benefits Excluding Employment Benefits	4,999	5,316	4,278	2,829	1,305	3,380
Benefit-Cost Ratio						
All Benefit Categories	1.5	1.5	1.3	1.2	1.2	1.4
Benefits Excluding Employment Benefits	1.4	1.4	1.3	1.1	1.1	1.3

a/ Annualized using 50-year project economic life.
b/ January 1997 price levels. Mitigation costs are included.

ECONOMIC ANALYSIS, STRUCTURAL FEATURE

Summary of Benefits

209. Annual benefits accruing as a result of implementation of Plan 2 including all benefit categories total $20,708,000. Annual benefits for the plan (summarized from Table 7-64) are presented in Table 7-65.

COSTS ANALYSES FOR PLAN 2

GENERAL

210. Costs for Plan 2 reflect January 1997 price levels and are presented for without- and with-mitigation features. Costs reflect a refinement of the costs presented in Tables 7-62 and 7-63 and are based on engineering and real estate requirements. The variations in costs for this plan resulted from a refinement of real estate costs to reflect contingencies, the inclusion of costs of a mitigation plan, and cultural resources curatorial needs. Engineering and design costs and construction management costs increased as average historically accepted percentages were applied in the initial screening process as opposed to those for Plan 2 which were based on a construction Project Management Plan (PMP).

211. Mitigation features were included to satisfy current planning guidelines. These mitigation features were designed to offset the fish and wildlife and environmental losses and other adverse impacts associated with construction and operation of a pumping plant. Construction of Alternative Plan 2 is estimated to require 3 years, with initiation of construction in 2003 and completion of construction in 2005.

TABLE 7-65
SUMMARY, ANNUAL BENEFITS, PLAN 2 a/
YAZOO BACKWATER AREA, MISSISSIPPI
(7-5/8 Percent Interest Rate Analysis)
($000)

Benefit Category	Without Mitigation	With Mitigation
INUNDATION REDUCTION		
Nonagricultural		
Structures		
Built-up	99	99
Rural	1,692	1,692
Emergency Costs		
Built-up	6	6
Rural	146	146
Flood Insurance Program Operating Costs		
Built-up	3	3
Rural	24	24
Streets, Built-up	77	77
Public Roads and Bridges	828	828
Subtotal	2,875	2,875
Agricultural		
Crops	13,149	13,149 a/
Noncrop	2,796	2,796 a/
Catfish Operations	362	362
Subtotal	16,307	16,307
Subtotal, Inundation Reduction	19,182	19,182
INTENSIFICATION		
Crops	191 a/	191 a/
SUBTOTAL (FLOOD CONTROL)	19,373	19,373
EMPLOYMENT	1,105	1,335
TOTAL	20,478	20,708

a/ Adjustment in project economic analysis (deletion of annual crop acreage amount to account for reforesting mitigation lands totaling 18,000 acres of low elevation, frequently flooded lands), incorporating proposed mitigation acreage.

First Costs

212. Total first costs (100 percent Federal funds) required for construction of Plan 2, excluding costs for the mitigation features, are estimated at $108,551,000 (Table 7-66). With-mitigation costs included, total first costs would be $131,178,000. Total investment costs, which include the project construction costs, costs for mitigation, and interest during construction, are estimated at $145,623,000 at the 7-5/8 percent discount rate. Without costs for mitigation features, the total investment costs are $120,504,000.

Annual Costs

213. Estimated annualized costs, applying the 7-5/8 percent discount rate and 50-year expected project economic life for implementation of the Base Plan 2, are presented in Table 7-66. Annual costs, based on total investment costs, excluding costs for land acquisition for mitigation, include amortization charges (interest and sinking fund costs), and costs for operation, maintenance, and major replacement costs for replacing the pumps (to be performed at year 35) as well as the annual costs associated with the mitigation features. With mitigation included, annual costs are estimated at $14,057,000 (Tables 7-66 and 7-67). Without mitigation, annual costs are estimated at $11,800,000.

TABLE 7-66
FIRST COSTS, ANNUAL COSTS
STRUCTURAL FEATURE (PLAN 2)
YAZOO BACKWATER AREA, MISSISSIPPI
(7-5/8 Percent Discount Rate Analysis)
($000)

	Without Mitigation	With Mitigation
First Costs a/		
Lands and Damages	--	--
Relocations	--	--
Levees and Floodwalls	741	741
Pumps	84,462	84,462
Channels and Canals	2,983	2,983
Floodway Control and Diversion Structures	--	--
Building, Grounds, Utilities	656	656
Permanent Operating Equipment	500	500
Mitigation	--	18,624
Planning, Engineering, and Design	10,262	13,496
Construction Management	8,947	9,717
Total First Costs	108,551	131,178
IDC b/	11,954	14,446
Total Investment	120,504	145,623
Annual Costs c/		
Amortization, Project	9,427	9,427d/
Amortization, Mitigation	--	1,965
Operation & Maintenance	752	752
Pump Operation (Elec. Energy)	1,486	1,486
Major Rehabilitation, Pumps	135	135
Mitigation Management	--	292
Cultural Resource Curation	--	--
Fish and Wildlife Losses	--e/	--e/
Total	11,800	14,057

a/ January 1997 price levels. All costs are Federal costs.
b/ Construction period is estimated to require 3 years (2003-2005).
c/ Annualized utilizing 7-5/8 percent discount rate and an expected 50-year project economic life.
d/ Based on total investment cost excluding the costs for mitigation features.
e/ Fish and wildlife losses are incorporated in mitigation analyses.

TABLE 7-67
ECONOMIC ANALYSES
STRUCTURAL FEATURE (PLAN 2)
WITHOUT- AND WITH-MITIGATION FEATURES
YAZOO BACKWATER AREA, MISSISSIPPI
(7-5/8 Percent Discount Rate Analysis)

Item	Without Mitigation	With Mitigation
First Cost ($000) a/	108,551	131,178
Annual Cost ($000) a/b/	11,800	14,057
Annual Benefits ($000) b/		
All Categories	20,607	20,837
All Categories Excluding Employment	19,502	19,502
Excess Benefits Over Costs ($000) c/	7,702	5,445
Benefit-Cost Ratios		
All Benefit Categories	1.75	1.48
Benefits Excluding Employment Benefits	1.65	1.38

a/ January 1997 price levels.
b/ Annualized utilizing a 50-year project economic life.
c/ Calculated using all benefits except employment benefits.

Summary of Economic Analysis

214. Economic analysis summary data are presented in Table 7-67. First costs for Plan 2 are estimated at $108.4 million excluding costs of mitigation features and $131.2 million with costs for mitigation included. Annual costs (utilizing the 7-5/8 percent discount rate) excluding mitigation for Plan 2 are $11,800,000. With mitigation features included, annual costs for Plan 2 were determined to be $14,057,000. Excluding employment benefits, annual benefits for Plan 2 were $19,502,000 with excess benefits over costs of $5,445,000 with a benefit-cost ratio of 1.4. With employment benefits included, the annual benefits for Plan 2 were $20,837,000 with excess benefits over costs of $6,780,000 and a benefit-cost ratio of 1.5.

215. An analysis was conducted to evaluate the most economical means of powering the pumps--electric or diesel. The results of this analysis indicated that diesel pumps could be constructed and operated more economically than electric pumps. Results of a comparison of a 14,000-cfs electric pumping plant and a 14,000-cfs diesel pumping plant are presented in Table 7-68. Benefits for these two alternatives are identical. First costs of the diesel plant are estimated to be $124 million and first costs of the electric plant are estimated at $131 million. Annual costs for the diesel pumping plant are $2 million less than the electric plant. Based on this analysis, diesel power is assumed for all further alternatives evaluated.

ADDITIONAL ECONOMIC ANALYSES

REFINEMENT OF NONSTRUCTURAL CONSIDERATIONS (RURAL AND BUILT-UP STRUCTURES)

216. Additional economic analyses in the reformulation study included the examination of implementing nonstructural measures in the Yazoo Backwater area. The Water Resources Development Act of 1986 requires that any Federal agency planning projects involving flood protection shall give full and equal consideration to nonstructural alternatives to prevent or reduce flood damages. Nonstructural alternatives include utilization of measures such as floodproofing, structure raising, relocation, acquisition/demolition, and/or the construction of small walls to provide flood protection/reduction to residential and other structures from a 100-year frequency flood event.

TABLE 7-68
ECONOMIC DATA FOR ELECTRIC VERSUS DIESEL POWER PUMP STATION
YAZOO BACKWATER AREA, MISSISSIPPI

Benefits a/	14,000 cfs	
	Electric b/	Diesel b/
Agricultural Crop ($000)	13,340	13,340
Agricultural Noncrop ($000)	2,796	2,796
Catfish ($000)	362	362
Structures ($000)	1,791	1,791
Road/Bridge ($000)	828	828
Emergency ($000)	152	152
Flood Insurance ($000)	27	27
Street ($000)	77	77
Total ($000)	19,373	19,373
Costs		
Construction Cost ($000)	108,907	102,000
Mitigation Cost ($000)	22,271	22,600
Total Construction Cost ($000)	131,178	124,000
Annual		
Amortization ($000) a/	11,392	10,786
Operation and Maintenance ($000)	2,530	1,288
Major Replacements ($000)	135	126
Total Annual ($000)	14,057	12,200
Excess Benefits ($000)	5,316	7,173
Benefit-Cost Ratio (%)	1.4	1.6

a/ Average annual values at 7-5/8 percent.

b/ Assumes year-round pump operation at 80 feet, NGVD.

217. Several nonstructural options were evaluated for structures located in the project area flood plain to determine the economic feasibility of these measures. Results of these evaluations indicated that 1,642 residential and nonresidential structures were situated at elevations below the 100-year frequency flood elevation. These structures were included in the nonstructural analyses. The implementation cost for each nonstructural category was calculated by structure and compared to the corresponding flood protection benefit.

218. Results of the nonstructural economic analyses are displayed in Table 7-69 by project reach by nonstructural alternative for the Yazoo Backwater area. The number of structures impacted by reach differ by nonstructural alternative, since not all structures possess equal opportunity for flood relief by each of the possible nonstructural features. None of the nonstructural flood reduction measures were determined to be economically feasible. For the total area, benefit-cost ratios ranged from 0.05 for acquisition/demolition to 0.15 for structure raising. Additionally, nonstructural alternatives provide only a limited solution to structural flood problems in the project area, and property owners have indicated a lack of willingness to accept these alternatives as solutions to project area structure flooding. Total costs of these measures ranged from $18.7 million for structure raising to $47.5 million for acquisition/demolition.

TABLE 7-69
ECONOMIC ANALYSIS SUMMARY
OF NONSTRUCTURAL MEASURES BY PROJECT REACH a/
BASE (WITHOUT-PROJECT) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 Values)

Item/Reach	No. of Structures	First Cost ($000)	Annual Cost ($000)	Annual Benefit ($000)	Benefit-Cost Ratio
Reach 1					
Floodproofing	545	9,317.0	728.9	127.4	0.17
Structure Raising	412	10,637.2	832.2	127.4	0.15
Small Walls	657	10,663.1	834.2	127.4	0.15
Relocation	412	20,024.6	1,566.5	100.9	0.06
Acquisition/Demolition	413	27,708.8	2,167.7	100.9	0.05
Reach 2					
Floodproofing	191	4,113.8	321.8	31.9	0.10
Structure Raising	149	4,219.2	330.1	31.9	0.10
Small Walls	205	4,122.5	322.5	31.9	0.10
Relocation	149	8,716.0	681.9	25.4	0.04
Acquisition/Demolition	149	11,291.4	883.3	25.4	0.03
Reach 3					
Floodproofing	75	985.3	77.1	13.7	0.18
Structure Raising	29	392.3	30.7	13.7	0.45
Small Walls	64	788.8	61.7	13.7	0.22
Relocation	29	701.5	54.9	12.8	0.23
Acquisition/Demolition	18	596.6	46.7	12.8	0.27
Reach 4					
Floodproofing	251	4,824.3	377.4	43.3	0.11
Structure Raising	142	3,450.2	369.9	43.3	0.16
Small Walls	260	5,027.6	393.3	43.3	0.11
Relocation	142	6,669.5	521.8	34.8	0.07
Acquisition/Demolition	139	7,885.1	616.9	34.8	0.06
Total Area					
Floodproofing	1,062	19,240.4	1,505.2	216.3	0.14
Structure Raising	732	18,698.9	1,462.9	216.3	0.15
Small Walls	1,186	20,602.0	1,611.7	216.3	0.13
Relocation	732	36,111.6	2,825.1	173.9	0.06
Acquisition/Demolition	719	47,481.9	3,714.6	173.9	0.05

a/ Nonstructural analyses based on 7-5/8 percent discount rate and existing conditions.

FINAL SCREENING OF ALTERNATIVES

219. The Vicksburg District held a series of three facilitated workshops to receive input from all groups interested in the Yazoo Backwater Reformulation effort. Many interest groups attended the meetings including environmentalists, farmers, and state and Federal agency employees. Preliminary results from analysis of several structural plans outlined in earlier sections of this study were presented. Also, several additional conceptual alternatives that contained totally nonstructural solutions and plans that contained a combination of structural and nonstructural solutions were outlined (Table 7-70). This second array of alternatives contained 9 nonstructural plans, 12 combination (structural/nonstructural) plans, and 6 structural plans. The combination plans utilized only the 14,000-cfs pumping plant. The nonstructural and combination structural/ nonstructural plans were composed of several nonstructural features. These features are used in different combinations in developing the described plans. These features include (1) conservation easements for reestablishment of forest lands, (2) conservation easements for cropland retained in its current use, (3) flowage easements that allow for ponding of water for use by waterfowl and other aquatics, and (4) preservation easements to ensure that existing woodlands remain in woods (are not cleared for agricultural or other purposes).

220. As a result of the consensus of the groups at the facilitated workshops, the conceptual plans presented were modified slightly and array three was developed. The plans evaluated consisted of three basic nonstructural features--reforestation, conservation easements (land use retained for cleared lands and preservation of existing woodlands), and water management, in combination with a pump (either the 14,000-cfs or 17,500-cfs pump), as well as the levee alternative. A total of 24 combination plans were evaluated (12 for each of 2 pump sizes). Each of these combination plans contains conservation easements for preserving existing woodland below specific elevations. Plans 3 through 14 include a 14,000-cfs pumping plant as the structural component of the plan, and Plans 15 through 26 include a 17,500-cfs pumping plant. Several of

TABLE 7-70
SECOND ARRAY OF ALTERNATIVES
YAZOO AREA BACKWATER, MISSISSIPPI

Plan	Easements			Easements	Reforestation	Mitigation	Pump	Total	Pump	Acres of Mitigation
	Conservation Easements on Woodlands	Reforestation/Open Lands	Flowage/Water Management a/	($ Million)						
NONSTRUCTURAL										
1	Preserved below 100.3 feet	Use Retained below 100.3 feet	N/A	217.0			N/A	217.0	N/A	
2	Preserved below 100.3 feet	Use Retained below 100.3 feet	Below 80.0 feet	235.3	0		N/A	235.3	N/A	
3	Preserved below 100.3 feet	Use Retained below 100.3 feet	Below 85.0 feet	253.2	0		N/A	253.2	N/A	
4	Preserved below 100.3 feet	Reforested below 85.0 feet	N/A	232.1	8.1		N/A	240.2	N/A	
5	Preserved below 100.3 feet	Reforested below 85.0 feet	Below 80.0 feet	255.0	8.1		N/A	263.1	N/A	
6	Preserved below 100.3 feet	Reforested below 85.0 feet	Below 85.0 feet	257.0	8.1		N/A	265.1	N/A	
7	Preserved below 100.3 feet	Reforested below 90.0 feet	N/A	246.5	15.7		N/A	262.2	N/A	
8	Preserved below 100.3 feet	Reforested below 90.0 feet	Below 80.0 feet	269.3	15.7		N/A	285.0	N/A	
9	Preserved below 100.3 feet	Reforested below 90.0 feet	Below 85.0 feet	280.1	15.7		N/A	295.8	N/A	
COMBINATION NONSTRUCTURAL-STRUCTURAL										
10	Preserved below 85.0 feet	Use Retained below 85.0 feet	N/A	48.9	0		102	150.9	14,000 cfs b/	
11	Preserved below 85.0 feet	Use Retained below 85.0 feet	Below 80.0 feet	59.2	0		102	161.2	14,000 cfs b/	
12	Preserved below 85.0 feet	Use Retained below 85.0 feet	Below 85.0 feet	75.1	0		102	177.1	14,000 cfs b/	
13	Preserved below 85.0 feet	Reforested below 85.0 feet	N/A	59.7	8.1		102	169.8	14,000 cfs b/	
14	Preserved below 85.0 feet	Reforested below 85.0 feet	Below 80.0 feet	68.9	8.1		102	179.0	14,000 cfs b/	
15	Preserved below 85.0 feet	Reforested below 85.0 feet	Below 85.0 feet	78.9	8.1		102	189.0	14,000 cfs b/	
16	Preserved below 90.0 feet	Use Retained below90.0 feet	N/A	82.5	0		102	184.5	14,000 cfs b/	
17	Preserved below 90.0 feet	Use Retained below90.0 feet	Below 80.0 feet	87.7	0		102	189.7	14,000 cfs b/	
18	Preserved below 90.0 feet	Use Retained below90.0 feet	Below 85.0 feet	103.6	0		102	205.6	14,000 cfs b/	
19	Preserved below 90.0 feet	Reforested below 90.0 feet	N/A	104.6	15.7		102	222.3	14,000 cfs b/	
20	Preserved below 90.0 feet	Reforested below 90.0 feet	Below 80.0 feet	111.8	15.7		102	229.5	14,000 cfs b/	
21	Preserved below 90.0 feet	Reforested below 90.0 feet	Below 85.0 feet	121.6	15.7		102	239.3	14,000 cfs b/	
22	Preserved below 100.3 feet	N/A	N/A	69.1		22.6	102	193.7	14,000 cfs b/	18,500
STRUCTURAL										
23	N/A	N/A	N/A			18.7	85	103.7	10,500 cfs c/	15,000
24	N/A	N/A	N/A			22.6	102	124.6	14,000 cfs c/	18,500
25	N/A	N/A	N/A			23.1	124	147.1	17,500 cfs c/	19,000
26	N/A	N/A	N/A			26.7	145	171.7	21,000 cfs c/	22,000
27	N/A	N/A	N/A			30.6	158	188.6	24,500 cfs c/	25,000
28	N/A	N/A	N/A			12.6	177	189.6	N/A	10,000

a/ 1 December to 1 March.
b/ A 14,000-cfs pump would be operated to reduce flood damages above easement elevations.
c/ Initiate pumping at 85 feet, NGVD, during 1 December to 1 March; initiate pumping at 80 feet, NGVD, during cropping

Notes:
Plans 1 through 9 are Nonstructural.
Plans 10 through 22 are Combination.
Plans 23 through 27 are standard plans, including a pump while Plan 28 is a structural levee plan along the Sunflower River.

the plans contain flowage easements for lands below elevation 80 feet, NGVD, or 85 feet, NGVD. Several plans evaluated reforestation of open agricultural lands below 85 feet, NGVD, or 90 feet, NGVD. Pump operation levels of 80 feet, NGVD; 85 feet, NGVD; and 90 feet, NGVD, were evaluated. Plan 27 is the traditional 14,000 cfs pumping plant alternative. Plan 28 is the traditional 17,500-cfs pumping plant alternative. Plan 29 is the traditional levee alternative. Plan 30 is the traditional 14,000-cfs pumping plant alternative with conservation easement for all existing woodlands below elevation 100.3 feet (approximately 159,000 acres).

221. Based on current criteria for plan selection, the traditional 14,000-cfs pump (Plan 27) remains the plan with the greatest excess benefits over costs. However, several of the combination plans had positive excess benefits, and these plans provide significantly more environmental benefits than Plan 27.

222. The final results of the analyses of the third array of alternatives are presented in Table 7-71. The evaluation of these proposed plans utilized data developed earlier in this study. The methodology used was consistent among plans. Results of the analyses indicated that the 14,000-cfs pump plant, alone or in combination with nonstructural features, was the plan that provided the greatest excess benefits over costs. In the group of combination plans, Plan 6 provided the greatest excess benefits over costs. As in earlier evaluations, the 14,000-cfs pump plant with associated mitigation is the plan with the greatest excess benefits over costs (Plan 27).

TABLE 7-71
THIRD ARRAY OF ALTERNATIVES
YAZOO BACKWATER AREA, MISSISSIPPI
($000)

Plan	Total Cost	Pump Cost	Easement Cost	Mitigation Cost	Annual Cost	Annual Benefits	Excess Benefits
1	261,364	--	261,364	--	19,238	--	(19,238)
2	329,655	--	329,655	--	24,265	(4,452)	(28,717)
3	193,661	120,195	42,113	31,353	16,365	16,242	(123)
4	210,391	120,635	63,519	26,237	17,548	16,242	(1,306)
5	228,606	120,635	81,734	26,327	18,890	16,242	(2,648)
6	187,193	120,195	66,998	--	15,574	16,900	1,326
7	201,819	120,634	81,185	--	16,654	16,900	246
8	213,346	120,635	92,711	--	17,503	16,900	(603)
9	24,551	120,195	85,229	19,127	18,522	13,387	(5,135)
10	228,478	120,635	102,022	5,821	18,675	13,387	(5,288)
11	243,518	120,635	117,063	5,820	19,783	13,387	(6,396)
12	276,598	120,195	156,403	--	22,155	13,883	(8,272)
13	280,781	120,635	160,146	--	22,466	13,883	(8,583)
14	282,795	120,635	162,160	--	22,615	13,883	(8,732)
15	219,727	143,411	42,113	34,203	18,562	18,052	(510)
16	236,594	143,858	63,519	29,217	19,756	18,052	(1,704)
17	254,809	143,858	81,734	29,217	21,097	18,052	(3,045)
18	210,409	143,411	66,998	--	17,532	18,159	627
19	225,043	143,858	81,185	--	18,612	18,159	(453)
20	236,569	143,858	92,711	--	19,461	18,159	(1,302)
21	251,464	143,411	85,229	22,824	20,783	14,794	(5,989)
22	253,252	143,858	102,022	7,372	20,763	14,794	(5,969)
23	268,094	143,858	117,063	7,173	21,855	14,794	(7,061)
24	299,815	143,411	156,404	--	24,113	14,917	(9,196)
25	304,006	143,858	160,148	--	24,424	14,917	(9,507)
26	306,020	143,858	162,162	--	24,573	14,917	(9,656)
27	160,725	120,195	--	40,530	13,990	17,539	3,549
28	191,640	143,411	--	48,229	16,636	19,664	3,028
29	234,237	215,072 a/	--	19,165	19,552	15,102	(4,450)
30	232,905	120,195	73,257	39,453	19,348	17,539	(1,809)

a/ Represents cost of levee construction.

223. Two nonstructural plans were evaluated. These plans consisted primarily of two nonstructural features--conservation easements for land use retained and reforestation. Plan 1 consisted of conservation easements on all lands below elevation 100.3 feet, NGVD, at a cost of $261.4 million. These easements allow existing land uses to continue, but would not allow for any changes that would intensify land use (land use retained). Plan 2 consisted of reforestation of lands below elevation 85 feet, NGVD, and conservation easements (land use retained) for all areas above 85 feet, NGVD, at a cost of $329.7 million. These plans would provide benefits of reduction of flood damages on those lands that are reforested, income from timber harvesting and income from hunting leases. The assumption was made that income could be derived from the sale of hunting leases on those lands that are to be reforested. Price levels utilized in this evaluation were the same as for the initial array. The discount rate used was 7-1/8 percent.

224. Subsequent to meeting with the Atlanta Regional Offices of the U.S. Fish and Wildlife Service and the Environmental Protection Agency, some modifications were made to some of the proposed combination plans. A final array of alternatives was developed. (Plan 1 is the no-action alternative.) Plan 2 consists of a nonstructural plan--reforestation easements for 107,000 acres of cropland below 91 feet, NGVD, would be purchased along with conservation easements for 217,716 acres of cropland. Total cost for Plan 2 is $291.0 million. Plan 3 consists of a 14,000-cfs pump plant with an 80-foot, NGVD, pump elevation and 27,435 acres of mitigation. Total first costs for this alternative is $153.7 million. Plan 4 consists of 40,600 acres of cropland reestablished in hardwoods to an elevation of 85 feet, NGVD. Total cost for this alternative is $154.7 million. Plan 5 consists of a 14,000-cfs pump plant with an 87-foot, NGVD, pump elevation and 62,500 acres of cropland reestablished in hardwoods. This is the tentatively selected nonstructural feature. Total cost of this alternative is $181.6 million (Table 7-72). Plan 6 consists of a 14,000-cfs pump plant with an 88.5-foot, NGVD, pump elevation and 77,300 acres of cropland reestablished in hardwoods. Total cost of this alternative is $196.3 million. Plan 7 consists of a 14,000-cfs pump plant with a 91-foot, NGVD, pump elevation and 107,000 acres of cropland reestablished in hardwoods. Total cost of this alternative is $274.6 million.

TABLE 7-72
SUMMARY, ECONOMIC ANALYSES
BENEFITS, COSTS, INTEREST DURING CONSTRUCTION, GROSS INVESTMENT, ANNUAL COSTS,
EXCESS BENEFITS OVER COSTS, EMPLOYMENT BENEFITS, BENEFIT-COST RATIOS
FINAL ARRAY OF ALTERNATIVES
YAZOO BACKWATER AREA, MISSISSIPPI
(6-5/8 Percent Discount Rate)

Item	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
Benefits ($000)						
Structural						
Agricultural Crop	--	12,934	10,085	9,763	8,708	6,274
Agricultural Noncrop	--	2,705	2,579	2,241	2,159	1,770
Structures	--	1,967	1,935	1,871	1,788	1,639
Road and Bridge	--	883	863	828	802	766
Urban Streets	--	90	89	83	80	66
Emergency Cost	--	170	168	158	152	126
FIA	--	31	31	30	29	25
Catfish	--	383	377	365	352	319
Total Structural	--	19,163	16,127	15,339	14,070	10,985
Nonstructural						
Agricultural Crop	380	--	1,027	1,162	854	380
Timber/Hunt Lease	2,488	--	608	936	1,158	2,488
Total Nonstructural	2,868	--	1,635	2,098	2,012	2,868
Employment	841	438	460	506	539	683
Structural	--	438	417	376	351	395
Nonstructural	841	--	43	130	188	384
TOTAL BENEFITS (Excluding Employment)	2,410	19,601	18,222	17,943	16,621	14,536
TOTAL BENEFITS (Including Employment)	1,569	19,163	17,762	17,437	16,082	13,853
Costs $(000)						
First Cost (Total Project)	291,001	153,710	154,732	181,595	196,274	274,654
Structural	--	115,233	140,391	134,978	127,913	120,383
Nonstructural	291,001	--	14,341	46,617	68,461	154,271

TABLE 7-72 (Cont)

Item	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
Interest During Construction	27,731	14,648	14,740	17,305	18,704	26,173
Structural	--	14,648	13,374	12,863	12,180	11,472
Nonstructural	27,731	--	1,366	4,442	6,524	14,701
Mitigation	--	38,477	--	--	--	--
GROSS INVESTMENT COSTS	318,732	168,358	169,472	198,900	214,978	300,827
Structural	--	129,881	153,765	147,841	140,093	131,855
Nonstructural	318,732	--	15,707	51,059	74,985	168,972
Annual Costs ($000)						
Structural						
Amortization	--	11,623	10,616	10,207	9,665	9,103
O&M Project	--	812	812	812	812	812
O&M Energy	--	379	253	183	142	76
O&M Mitigation	--	334	--	--	--	--
Pump Replacement	--	154	154	154	154	154
Nonstructural						
Amortization	22,005	--	1,085	3,525	5,177	11,666
TOTAL ANNUAL COSTS	22,005	13,302	12,920	14,881	15,950	21,811
Structural	--	13,302	11,835	11,356	10,773	10,145
Nonstructural	22,005	--	1,085	3,525	5,177	11,666
Total Benefits (Including Employment) ($000)	2,410	19,601	18,222	17,943	16,621	14,536
Structural	--	19,601	16,544	15,715	14,421	11,380
Nonstructural	2,410	--	1,678	2,228	2,220	3,252
Total Benefits (Excluding Employment Benefit) ($000)	1,569	19,163	17,762	17,437	16,082	13,853
Structural	--	19,163	16,127	15,339	14,070	10,985
Nonstructural	1,569	--	1,635	2,098	2,012	2,868
Excess Benefits (Excluding Employment Benefit) ($000)	(20,436)	5,861	4,842	2,557	131	(7,960)
Excess Benefits (Including Employment Benefit) ($000)	(19,595)	6,299	5,302	3,063	670	(7,181)
Benefit-Cost Ratio (Excluding Employment Benefit)	0.07	1.44	1.37	1.19	1.03	0.64
Benefit-Cost Ratio (Including Employment Benefit)	0.11	1.47	1.41	1.23	1.07	0.67

225. Benefits and costs for each alternative presented in this final array were calculated utilizing current Federal Water Resources Guideline II Fiscal Year 1999 agricultural prices, the most current data available. Project costs are based on December 1999 price levels and a 6-5/8 percent discount rate (Table 7-72) as well as 2-1/2 percent discount rate (Table 7-73). The 6-5/8 percent discount rate is the Fiscal Year 2000 rate and 2-1/2 percent is the authorized discount rate--the rate purported for use in discounting Water Resources Projects' values.. Agricultural benefits accruing to the nonstructural features of the alternative plans were estimated according to guidance presented in Engineer Regulation 1105-2-100.

226. Structural and nonstructural benefits were identified for each of the proposed plans in the final array. Nonstructural agricultural crop benefits consist of insurable flood losses. Insurable flood loss reduction was calculated for lands to be taken out of production through nonstructural flood damage reduction features. Insurable losses are calculated by reducing annual flood losses by subtracting flood losses not covered by insurance (noninsurable losses), the deductible portion of losses, and the annual cost of the insurance premium paid by farmers. The analysis of insurable flood losses is based on data provided by the Risk Management Agency and on information taken from their web site.

227. Average annual flood damages were based on data computed utilizing the Vicksburg District's CACFDAS. Data for the cost of the annual premium paid by farmers are based on information from the Risk Management Agency. Data for hydrologic Reach 1 were based on information for Issaquena County, Mississippi. Data for Reaches 2, 3, and 4 were based on information for Sharkey County, Mississippi. Premium cost paid by farmers was estimated to be $4.48 per acre for Reach 1 and $6.53 per acre for Reaches 2, 3, and 4.

228. Nonstructural agricultural crop benefits ranged from $380,000 for Plan 7 to $1,162,000 for Plan 5.

229. Benefits for timber are based on data from Dr. Leonard Shabman's report entitled, "An Approach for Evaluating Nonstructural Actions with Application to the Yazoo River (Mississippi) Backwater Area," which indicated that returns for reforestation would be essentially equal to the costs of reforestation of the area; i.e., $140 per cleared acre. The assumption was made that benefits for timber would be equal to the annualized costs of reforestation (costs for planting trees only). Benefits for hunting leases were based on information from discussions with some of the larger landowners in the Basin. It was assumed that leases would be small for the first 10 years; i.e., $2 per acre. Hunting leases were assumed to increase to $10 per acre for the last 10 years of the expected project economic life. Reforestation costs were estimated to be $6,359,000. Total costs were $46,617,000.

230. In removing lands from production, damages are removed; however, there is also a loss of net returns above damages that no longer accrue to the reforested area. Benefits that accrue from the change in land use from crops to forest land are comprised of returns to timber and the lease of hunting rights. These benefits ranged from $608,000 for Plan 4 to $2,488,000 for Plan 7 (Table 7-72). Plan 3 provided the greatest excess benefits over costs of all the plans evaluated at the 6-5/8 and 2-1/2 percent discount rates. However, the environmental benefits of the other plans evaluated are significantly greater than those of Plan 3. A discussion of the incremental analysis used in plan selection is presented in the Main Report of this study. Utilizing nonstructural flood control to provide flood reduction in the more frequently flooded areas would provide reduced flood damages in these areas along with tremendous improvements in wildlife habitat. Based on this logic, Plan 5 is chosen as the recommended plan. Plan 5 provides extensive benefits to agricultural interests and lowers damages to residential and nonresidential structures as well as all other evaluated benefit categories. These economic benefits are realized along with significant net gains in terrestrial, wetland, and aquatic resources in the project area. Plan 5 provides for the reestablishment of 62,500 acres of hardwood forests below the 87-foot, NGVD, elevation. Plan 5 provides the optimum solution to the current problematic water resources and environmental circumstances in the Yazoo Backwater area.

TABLE 7-73
SUMMARY, ECONOMIC ANALYSES
BENEFITS, COSTS, INTEREST DURING CONSTRUCTION, GROSS INVESTMENT, ANNUAL COSTS,
EXCESS BENEFITS OVER COSTS, EMPLOYMENT BENEFITS, BENEFIT-COST RATIOS
FINAL ARRAY OF ALTERNATIVES
YAZOO BACKWATER AREA, MISSISSIPPI
(2-1/2 (MR&T) Percent Discount Rate)

Item	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7
Benefits ($000)						
Agricultural Crop	0	13,910	12,340	12,274	10,973	8,077
Agricultural Noncrop	0	2,934	2,786	2,411	2,332	1,912
Structures	0	1,967	1,935	1,871	1,788	1,639
Road and Bridge	0	899	879	893	817	780
Urban Streets	0	91	90	85	82	68
Emergency Cost	0	170	168	158	152	126
FIA	0	31	31	30	29	25
Catfish	0	383	377	365	352	319
Timber/Hunt Lease	1,569	0	527	936	1,158	1,569
Employment (Including Mitigation)	406	211	222	244	260	605
TOTAL (Excluding Employment Benefit)	1,569	20,385	19,132	19,023	17,681	14,514
TOTAL (Including Employment Benefit)	1,975	20,596	19,355	19,267	17,941	15,119
Costs $(000)						
First Cost (Total Project)	291,001	153,710	154,732	181,595	196,274	274,000
Interest During Construction	10,290	5,435	5,471	6,421	6,940	9,688
First Cost (Mitigation)	--	38,477	--	--	--	--
GROSS INVESTMENT COSTS	301,291	159,145	160,204	188,016	203,214	283,688
Annual Costs ($000)						
Amortization	20,802	5,611	5,649	6,629	7,165	10,003
O&M (Project)	0	812	812	812	812	812
O&M (Energy: Diesel)	0	379	253	183	142	76
O&M (Mitigation)	0	334	--	--	--	--
Pump Replacement Cost	0	314	314	314	314	314
TOTAL ANNUAL COSTS	20,802	7,450	7,028	7,938	8,434	11,205
Excess Benefits (Excluding Employment Benefit)	-19,233	12,934	12,105	11,085	9,248	3,309
Excess Benefits (Including Employment Benefit)	-18,827	13,146	12,327	11,329	9,508	3,914
Benefit-Cost Ratio (Excluding Employment Benefit)	0.08	2.74	2.72	2.40	2.10	1.30
Benefit-Cost Ratio (Including Employment Benefit)	0.09	2.76	2.75	2.43	2.13	1.35

231. Table 7-74 presents first costs, annual costs, benefits, excess benefits, and benefit-cost ratios for the recommended plan at both 6-5/8 and 2-1/2 percent discount rates. Total benefits of the recommended plan are estimated to be $21.5 million at the current discount rate of 6-5/8 percent, excluding employment benefits. Annual costs are estimated to be $14.9 million. Net benefits excluding employment benefits are estimated at $6.6 million. Total annual nonstructural benefits for the recommended plan are estimated to be $3.9 million based on this analysis.

232. Agricultural benefits presented in Table 7-74 were updated to include 1999 crop budgets and 1999 current normalized (Guideline II) prices. Since data for urban structures analyses were initially collected for this reevaluation study almost 10 years ago, an inventory update for project area structures was needed. A recently updated inventory was consequently completed of the 100-year flood plain within the project area. This updated inventory identified a number of new structures within the study area. The majority of these structures are located in the Eagle Lake area with a lesser amount in other areas. Structure elevations for this updated inventory were estimated through the use of a digital elevation model developed for the Yazoo Backwater Area. Based on the latest structure inventory of the project area, only one structure is impacted at the 2-year frequency elevation. At the 5-year frequency elevation, 351 structures are impacted within the project area. The depreciated replacement values of the structure inventory were determined through appraisal techniques and through utilization of the Marshall-Swift computer software. Existing damages were estimated to be $2,580,000 annually. Damages remaining for with-project conditions were estimated to be $324,000 annually. Benefits for this category were estimated to be $2,256,000 (Table 7-74). Zero net growth of the number and current value of area structures is projected to occur over the expected economic project life. A total of 1,642 structures are estimated to be damaged with existing hydraulic conditions. Of this total of structures, 1,487 are residential structures. With the hydraulic conditions for the recommended plan, 478 total structures are damaged with 436 classified as residential structures. Although this updated

TABLE 7-74
RECOMMENDED PLAN
SUMMARY ECONOMIC ANALYSIS
YAZOO BACKWATER AREA
(6-5/8 and 2-1/2 Percent Discount Rates)

Item	6-5/8 Percent Discount Rate	2-1/2 Percent Discount Rate
Benefits ($000)		
Structural		
Agricultural Crop a/	11,639	12,553
Agricultural Noncrop	2,241	2,411
Structures b/	2,256	2,256
Road and Bridge	828	893
Urban Streets	83	85
Emergency Costs	158	158
FIA	30	30
Catfish	365	365
Nonstructural		
Agricultural Crop c/	2,960	3,183
Timber/Hunting Leases	936	936
Subtotal Nonstructural	3,896	4,119
Employment	506	244
Total Annual Benefits ($000)		
(Excluding Employment)	21,496	22,870
(Including Employment)	22,002	23,114
First Cost ($000)	181,595	181,595
Interest During Construction ($000)	17,305	6,421
Gross Investment ($000)	198,900	188,016
Annual Costs ($000)		
Amortization	13,732	6,629
O&M Project	812	812
O&M Energy	183	183
Pump Replacement	154	314
Total	14,881	7,938
Excess Benefits ($000)		
(Excluding Employment)	6,615	14,932
(Including Employment)	7,121	15,176
Benefit-Cost Ratio		
(Excluding Employment)	1.44	2.88
(Including Employment)	1.48	2.91

a/ Agricultural crop benefits include FY 99 Current Normalized Guideline II Commodity Prices and 1999 agricultural crop budgets published by MSU MAFES.

b/ Structure data based on updated structure surveys conducted in the spring of 2000 (current year 2000 values).

c/ Benefits consist of insurable losses.

inventory depicts that a no growth projection in the study area may slightly understate growth over the project life, the rate of growth in the entire project area is projected to be zero throughout the 50-year projection period, reflecting a short-lived increase in recent construction numbers.

SENSITIVITY ANALYSIS

233. The projections for the analyses presented in this evaluation are based on data from Census of Agriculture, U.S. Department of Commerce. Historical data for value of agricultural crops per harvested acre for the two primary counties in the study area were utilized through 1987. The values for the 1992 and 1997 Census Reports are not included at this time. The Bureau of Economic Analysis does not report price deflators for agricultural products any longer. We are attempting to obtain unpublished documents that contain these values. In the interim, a sensitivity analysis was performed to evaluate the impacts of alternative rates of growth on the agricultural crop benefits since agricultural benefits compile the primary benefit category. The sensitivity analysis consisted of reducing the growth rate used to project agricultural crop benefits in earlier portions of this report by 25 percent, 50 percent, and 75 percent. This analysis resulted in reductions in agricultural crop benefits from the $14.6 million (total structural and nonstructural in Table 7-74). The resulting reductions produced crop benefits of $13.5 million for a 25 percent reduction, $12.5 million for 50 percent reduction, and $11.5 million for the 75 percent reduction (totals for both structural and nonstructural features). The recommended plan would remain justified even at the 25 percent growth rate.

ATTACHMENT 7A

STRUCTURAL RISK AND UNCERTAINTY ANALYSIS
YAZOO BACKWATER AREA, MISSISSIPPI

GENERAL

1. The purpose of this section is to describe the application of risk and uncertainty in the assessment of flood damages and benefits for the Yazoo Backwater project. Reliability and effectiveness of water resources project improvement benefits can be addressed within the risk framework. Project analyses conducted within this framework yield expected mean flood benefits and the corresponding standard deviations. The @RISK program is a computer program that evaluates the Hydrology/Hydraulics and Economic variables within the ranges determined and within set limits. Individual and combined variable uncertainties are determined for their influence in the calculation of flood damages and the resulting benefits.

2. In an @RISK analysis, the output probability distributions provide a complete reflection of all possible outcomes within a statistical modeling scenario. The probability distribution determines a "correct range" due to the uncertainty associated with every input variable. Also, a probability distribution presents the relative likelihood of occurrence for each possible outcome. Instead of simple comparison between desirable and undesirable outcomes in the analysis, risk and uncertainty analyses provide information that certain outcomes are more likely to occur than others, thereby allowing more influence in the evaluation. This process has an advantage over traditional sensitivity analyses since a probability distribution graphically displays the probabilities and provides a barometer for the risk involved.

3. Base (without-project) hydrologic conditions indicate that properties in several built-up areas and adjacent rural areas within the 100-year delineated Yazoo Backwater project area are subject to flood damages. Portions of four "built-up" areas (Rolling Fork, Cary, Eagle Lake, and Holly Bluff) as well as adjacent impacted rural areas are inundated by the Big Sunflower River and the Yazoo River (and its tributaries) backwater flooding. Preliminary investigations identified a total of 2,857 structures within the delineated Yazoo Backwater project area. Displayed in Table 7A-1, these consisted of 2,320 residential and 537 nonresidential structures. Structures affected by flooding include residential, commercial, professional, industrial, public, semipublic, recreational, and warehouse structures in both the built-up and rural areas. Although all of these structures are located within the project area, not all are subject to flooding.

TABLE 7A-1
RESIDENTIAL AND NONRESIDENTIAL STRUCTURES
LOCATED IN PROJECT AREA a/
YAZOO BACKWATER AREA, MISSISSIPPI

Structure Category	Total Number of Structures	Percentage of Total
Residential	2,320	81
Nonresidential	537	19
TOTAL b/	2,857	100

a/ All structures are not necessarily subject to inundation/flood damages by backwater flooding.
b/ Based on structure surveys conducted by the U.S. Army Corps of Engineers, Vicksburg District, 1990-1992.

Data Correlation - Structural Characteristics
Versus Hydrologic Impacts

4. In determining flood damages to structural properties subject to flooding within the project area, a comprehensive inventory was conducted to collect structural data, by type, value and

first-floor elevation. Traditional analyses involved the correlation of structural and hydrologic data, utilizing a computer model (called URBAN) to calculate flood damages for without- and with-project conditions. This process is described in detail in Appendix 7.

Structural Flood Damage Impacts

5. Results of traditional structural flood damage analyses of the existing Yazoo Backwater project area indicate that a 100-year frequency flood event would cause flood damages to an estimated 1,555 structures. An analysis of these structures reflects that 140 structures were located in the built-up areas and 1,415 were in rural areas. Table 7A-2 presents a summary of the number of structures flooded in the project area by reach in the built-up areas. The number of rural structures subject to flooding is summarized by hydrologic reach in Table 7A-3. Table 7A-4 presents a summary of the total number of existing built-up and rural structures subject to flooding from a 100-year frequency flood event in the project impacted area.

Structural Flood Damages for Selected Frequencies

6. Output from the URBAN computer program provides an analysis of the number of structures as well as an estimate of damages for various flood frequencies. Graphic illustration of the number of structures receiving flood damages by selected flood frequencies is displayed in Figure 7A-1. Estimated damages and number of structures impacted for selected flood frequency events are presented in Table 7A-5 for base (without-project) conditions. Approximately $17.9 million in flood damages occur to existing properties in the project area from a 100-year frequency flood event for without-project conditions (Table 7A-5). With implementation of initial array Plan 2, this amount would be reduced to approximately $2.6 million (Table 7A-6).

TABLE 7A-2
NUMBER OF STRUCTURES RECEIVING FLOOD DAMAGES, BUILT-UP AREAS a/
BY REACH AND MAJOR PROPERTY CATEGORY
BASE (WITHOUT-PROJECT) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI

Built-Up Area	Residential	Nonresidential	Total
Reach 1			
Eagle Lake Community, Mississippi	102	5	107
Cary, Mississippi	--	--	--
Subtotal	102	5	107
Reach 2			
Cary, Mississippi	2	--	2
Rolling Fork, Mississippi	--	3	3
Subtotal	2	3	5
Reach 3			
Subtotal	0	0	0
Reach 4			
Holly Bluff, Mississippi	17	11	28
Subtotal	17	11	28
TOTAL AREA			
Eagle Lake, Mississippi	102	5	107
Cary, Mississippi (Reaches 1 and 2)	2	--	2
Rolling Fork, Mississippi	0	3	3
Holly Bluff, Mississippi	17	11	28
TOTAL AREA	121	19	140

a/ Structures receiving flood damages from a 100-year frequency flood event. Output from URBAN Computer Program based on structure surveys, 1990-1992.

TABLE 7A-3
NUMBER OF STRUCTURES RECEIVING FLOOD DAMAGES, RURAL AREAS a/
BY REACH AND MAJOR PROPERTY CATEGORY
BASE (WITHOUT-PROJECT) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI

Rural Area Reach	Number of Damaged Structures		
	Residential	Nonresidential	Total
Reach 1	680	112	792
Reach 2	136	17	153
Reach 3	98	90	188
Reach 4	221	61	282
TOTAL AREA	1,135	280	1,415

a/ Structures receiving flood damages from a 100-year frequency flood event. Output from URBAN Computer Program.

TABLE 7A-4
TOTAL NUMBER OF STRUCTURES FLOODED a/
BY REACH AND MAJOR PROPERTY CATEGORY
BASE (WITHOUT-PROJECT) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI

Reach	Total Number of Damaged Structures		
	Residential	Nonresidential	Total
Reach 1			
Built-Up Area	102	5	107
Rural Area	680	112	792
Subtotal	782	117	899
Reach 2			
Built-Up Area	2	3	5
Rural Area	136	17	153
Subtotal	138	20	158
Reach 3			
Built-Up Area	0	0	0
Rural Area	98	90	188
Subtotal	98	90	188
Reach 4			
Built-Up Area	17	11	28
Rural Area	221	61	282
Subtotal	238	72	310
TOTAL			
Built-Up Area	121	19	140
Rural Area	1,135	280	1,415
TOTAL AREA	1,256	299	1,555

a/ Structures receiving flood damages from a 100-year frequency flood event. Output from URBAN Computer Program.

Figure 7A-1
Number of Structures Damaged by Frequency
Base (Without-Project) Conditions

Yazoo Backwater Area, Mississippi

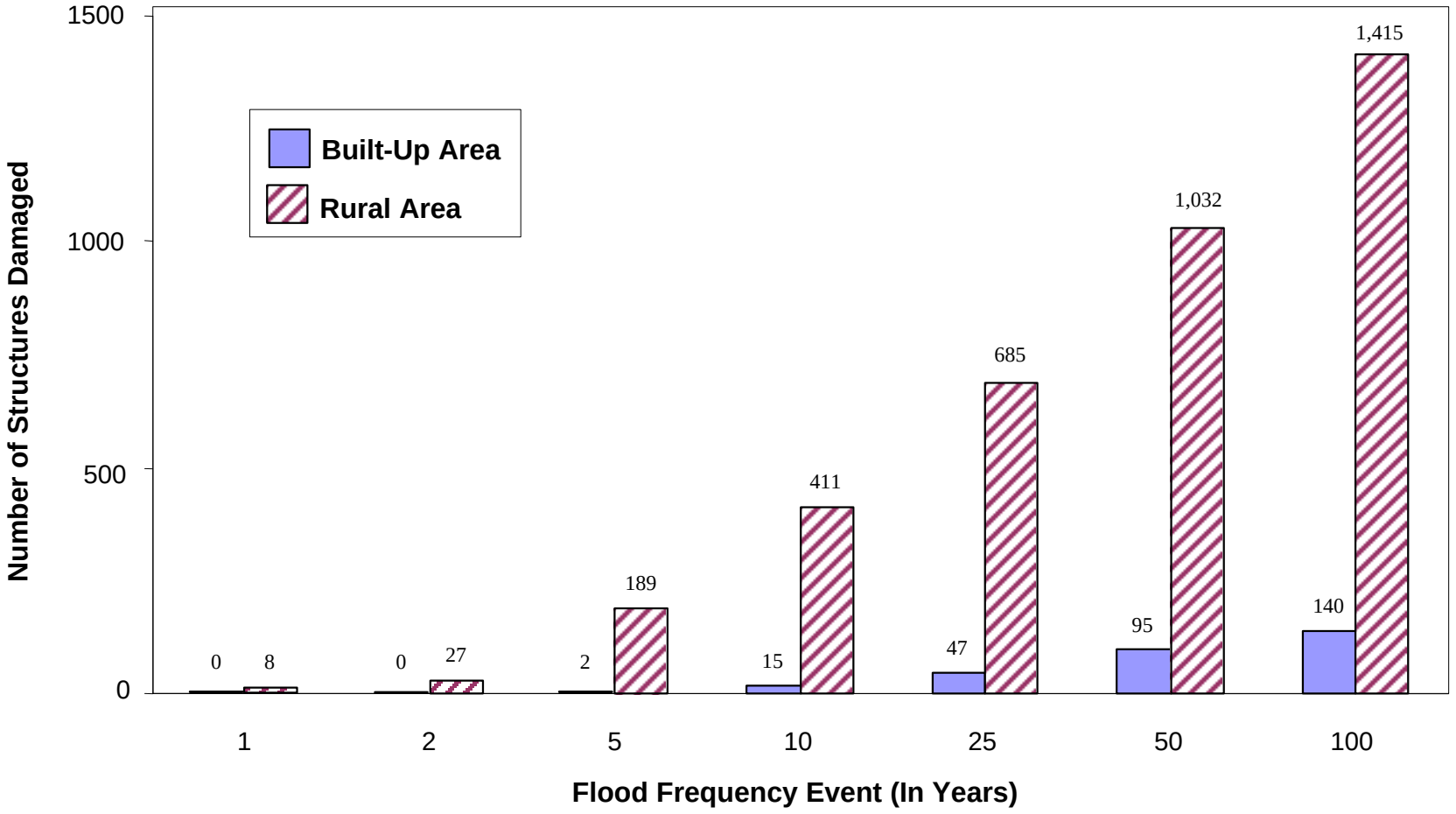


TABLE 7A-5
NUMBER OF STRUCTURES IMPACTED AND ASSOCIATED
FLOOD DAMAGES BY FREQUENCY OF FLOODING
BASE (WITHOUT-PROJECT) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI

Frequency (yr)	Number of Structures			Damages a/		
	Built-Up Area	Rural Area	Total Area	Built-Up Area ($000)	Rural Area ($000)	Total Area ($000)
100	140	1,415	1,555	1,271	16,614	17,885
50	95	1,032	1,127	665	10,666	11,331
25	47	685	732	287	7,489	7,776
10	15	411	426	66	4,069	4,135
5	2	189	191	7	1,737	1,744
2	0	27	27	0	100	100
1	0	8	8	0	63	63
Average Annual Damage				108	1,640	1,748
Damage Per Structure ($) b/				771	1,159	1,124

a/ 1996 values.
b/ Actual dollar values--not in thousands of dollars.

TABLE 7A-6
NUMBER OF STRUCTURES IMPACTED AND ASSOCIATED
FLOOD DAMAGES BY FREQUENCY OF FLOODING
WITH-PROJECT CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI

Frequency (yr)	Number of Structures			Damages a/		
	Built-Up Area	Rural Area	Total Area	Built-Up Area ($000)	Rural Area ($000)	Total Area ($000)
100	6	274	280	18	2,574	2,592
50	2	159	161	6	1,561	1,567
25	2	79	81	b/	816	816
10	0	24	24	0	95	95
5	0	14	14	0	28	28
2	0	0	0	0	0	0
1	0	0	0	0	0	0
Average Annual Damage				5	176	181
Damage Per Structure ($) c/				833	642	646

a/ 1996 values.
b/ Less than $500.
c/ Actual dollar values--not in thousands of dollars.

Existing Annual Flood Damage to Built-Up and Rural Structures

7. Table 7A-7 provides a summary of the flood damage results from the URBAN computer program for properties within the Yazoo Backwater area. The total annual flood damages to built-up areas was estimated at approximately $108,000 for base (without-project) conditions (expressed in 1996 values). Table 7A-8 presents a summary of the estimated annual flood damages for rural residential and nonresidential structures. The total annual flood damages to rural areas were approximately $1,640,000. Structural flood damages to the total Yazoo Backwater area are estimated at $1,748,000 annually.

TABLE 7A-7
AVERAGE ANNUAL FLOOD DAMAGE TO BUILT-UP AREA STRUCTURES
BY REACH AND MAJOR PROPERTY CATEGORY a/
BASE (WITHOUT-PROJECT) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 Values)

Built-Up Area	Average Annual Flood Damage to Structures ($000)		
	Residential	Nonresidential	Total
Reach 1			
Eagle Lake Community, Mississippi	59	1	60
Cary, Mississippi	1	b/	1
Subtotal	60	1	61
Reach 2			
Cary, Mississippi	2	22	24
Rolling Fork, Mississippi	7	4	11
Subtotal	9	26	35
Reach 3			
Subtotal	b/	b/	b/
Reach 4			
Holly Bluff, Mississippi	8	4	12
Subtotal	8	4	12
TOTAL AREA			
Eagle Lake Community, Mississippi	59	1	60
Cary, Mississippi (Reaches 1 and 2)	3	22	25
Rolling Fork, Mississippi	7	4	11
Holly Bluff, Mississippi	8	4	12
TOTAL AREA	77	31	108

a/ Output from URBAN Computer Program.
b/ Less than $500.

TABLE 7A-8
AVERAGE ANNUAL FLOOD DAMAGE TO RURAL STRUCTURES
BY REACH AND MAJOR PROPERTY CATEGORY a/
BASE (WITHOUT-PROJECT) CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 Values)

Rural Area Reach	Average Annual Flood Damage to Structures ($000)		
	Residential	Nonresidential	Total
Reach 1	630	580	1,210
Reach 2	94	16	110
Reach 3	124	88	212
Reach 4	74	34	108
TOTAL AREA	922	718	1,640

a/ Output from URBAN Computer Program.

Annual Structural Flood Damages for
Without- and With-Project Conditions

8. Table 7A-9 presents a comparison of annual built-up and rural area structure flood damages for without- and with-project (initial array Plan 2) conditions. Economic analyses identified the 14,000-cubic-foot-per-second (cfs) pump (initial array Plan 2) as the most effective pump size. With implementation of this plan of improvement, flood damages to structures (residences, commercial and industrial buildings, public and semipublic buildings, etc.) in the built-up areas would be reduced by 95 percent, from $108,000 annually to $5,000 annually. In the rural sector of the project area, annual damages to residences, etc., would be reduced by 89 percent, from $1,640,000 annually to $176,000 annually. For the total project area, the initial array Plan 2 would reduce built-up area and rural area flood damages by 90 percent, from $1,748,000 annually to $181,000. Table 7A-9 also presents values for the 2006 and 2055 future years.

TABLE 7A-9
AVERAGE ANNUAL FLOOD DAMAGES TO BUILT-UP AND
RURAL AREA STRUCTURES a/
BASE (WITHOUT-PROJECT) AND WITH-PROJECT CONDITIONS
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 Values)

Item/Year	Average Annual Flood Damage to Structures ($000)	
	Base (Without-Project) Conditions	With-Project (Initial Array Plan 2) Conditions
1996 - 2055 b/		
Built-Up Area		
Residential	77	5
Nonresidential	31	c/
Total	108	5
Rural Area		
Residential	922	87
Nonresidential	718	89
Total	1,640	176
Total Area		
Residential	999	92
Nonresidential	749	89
Total	1,748	181

a/ Output from URBAN Computer Program.
b/ Flood damages associated with built-up area and rural area flooding are held constant over the estimated project economic life (2006-2055).
c/ Less than $500.

SECTION 2 - PRELIMINARY RISK AND UNCERTAINTY ANALYSES

@RISK METHODOLOGY

9. The risk-based approach to urban flood damage analysis incorporates risk and uncertainty into the computation of flood damages for specified events by using a simulation technique in which multiple iterations selected from a full range of possible values for each variable identified as a source of uncertainty. The analysis is accomplished by considering the range of possible values (maximum and minimum values for each input variable in the flood damage calculation) and distribution of the likely occurrence of outcomes over the specified range.

10. The risk-based program, developed from LOTUS and @RISK computer technology, uses Monte Carlo simulation to derive the possible variable occurrences. Monte Carlo simulation utilizes randomly generated numbers to simulate the occurrences of selected key variables from established ranges and distributions. In a normal distribution, 68 percent of the occurrences of a particular outcome would be within one standard deviation from (on either side of) the mean (expected value), 95 percent within two standard deviations from the mean, and 99.7 percent within three standard deviations from the mean. Key variables identified as sources of uncertainty were structure value, contents value, first floor elevation, depth-damage relationships, and stage-frequency data. The computerized Latin Hypercube sampling technique was used to sample within the range of values. With each sample or iteration in the program, a value is selected and the sum of all sampled values divided by the number of samples yields the mean (expected value). This routine is accomplished simultaneously for each structure on each key variable to calculate the stage-damage curve. A minimum of 10,000 iterations were performed to assure a full range of possible outcomes.

PRELIMINARY STRUCTURAL
FLOOD DAMAGE ANALYSES

11. Based on risk and uncertainty procedures outlined in Engineer Circular 1105-2-205, the Water Resources Support Center and the Hydrologic Engineering Center utilized LOTUS and @RISK computer software to develop several economic and hydrologic models, or templates, to be used in the analyses of structural flood damages. These programs analyze the reliability and effectiveness of various project improvements, and also account for uncertainties associated with key economic and hydrologic parameters. The traditional concept of integrating flood depths, frequency, and damage data continue to be utilized in the determination of flood damages except, with the risk approach, an attempt is made to explicitly quantify the uncertainty variables. Structural, depth-damage, and damage-frequency data from the URBAN computer program were utilized as input for the risk and uncertainty analyses.

12. In the economic evaluation of structure flood problems in the Yazoo Backwater project area, two types of @RISK models were employed--an economic (stage-damage) template and a hydrologic template. The economic model was utilized to develop a stage-damage relationship and corresponding uncertainty for the existing (without-project) hydrologic conditions in each flood damage reach. The hydrologic templates, which are based on specific types of project improvements, utilize stage-damage and stage-frequency relationships with uncertainty to evaluate flood damages for each set of project conditions. In the Yazoo Backwater area, the non-levee analysis template was used to evaluate various-sized pumping plant alternatives. Utilizing the risk-based framework, estimated annual structural flood damages (including uncertainty) were computed for each of the project reaches.

The Economic Stage-Damage Model

13. The economic stage-damage model utilizes a simulation technique to incorporate risk and uncertainty into the calculation of flood damages for specified flood events. Multiple iterations

were performed to select or sample from the full range of possible values for key variables identified with uncertainty. The resulting stage-damage relationship and corresponding uncertainty were then integrated with the stage-frequency relationship and its corresponding uncertainty in the appropriate hydrologic template to determine the expected annual without- and with-project flood damages.

14. Preliminary risk analyses were conducted on structural flood damages in the Yazoo Backwater project area to develop stage-damage relationships for each of the built-up and rural areas previously identified. The @Risk program also calculated the standard deviations that corresponded with the stage-damage results. The standard deviation is a measure of variability that is extremely useful, since it has the capability for comparing sets of measurements, as well as describing a single set of measurements. The standard deviation is used to represent any uncertainties in key hydrologic or economic parameters. The results of the stage-damage analysis for base (without-project) conditions in the Yazoo Backwater project area are presented in Table 7A-10 for each reach. Preliminary analyses were based on structural data collected in 1990-1992 (expressed in 1996 values).

The Hydrologic Model

15. The risk-based hydrologic model used in project analyses is dependent upon the existing hydrologic conditions and the type of flood control improvement under evaluation. In the evaluation of flood control improvements in the Yazoo Backwater area, the non-levee hydrologic template (based on stage-frequency) was used in analyzing the uncertainty associated with hydrologic parameters. Uncertainties in hydrologic/hydraulic analyses are generally associated with stage and discharge. Some of this uncertainty exists because of short record lengths, sampling errors, imprecise measurements of data, etc. Stages can also be affected by conveyance roughness, cross-section geometry, debris accumulation, etc.

TABLE 7A-10
RESULTS OF THE PRELIMINARY STAGE-DAMAGE STRUCTURAL ANALYSES
BASE (WITHOUT-PROJECT) CONDITIONS
BASED ON RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 Values)

Existing Structural Stage-Damage By Reach a/			
Flood Frequency Event	Stage (ft, NGVD)	Structure Damage ($000) b/	
		Built-Up Area	Rural Area
Reach 1			
1	87.0	0.0	11.9
2	91.0	0.0	175.2
5	94.8	33.9	2,005.7
10	96.3	150.4	4,234.4
25	98.0	174.8	7,799.3
50	99.2	911.4	11,499.7
100	100.3	1,486.3	15,980.0
Reach 2			
1	87.8	0.0	0.0
2	91.8	0.0	1.9
5	95.3	0.0	124.2
10	96.8	0.0	331.1
25	98.6	0.0	876.8
50	99.5	154.6	1,379.0
100	100.3	404.9	2,001.3
Reach 3			
1	87.8	0.0	5.8
2	91.8	0.0	99.7
5	95.3	0.0	504.4
10	96.8	0.0	926.5
25	98.6	0.0	1,663.4
50	99.5	0.0	2,108.7
100	100.3	0.0	2,534.9
Reach 4			
1	87.8	0.0	0.0
2	91.8	0.0	0.0
5	95.3	0.0	37.3
10	96.8	0.0	191.9
25	98.6	62.8	936.3
50	99.5	149.1	1,761.2
100	100.3	280.0	2,821.1

a/ Output from preliminary risk-based analyses based on structure surveys, 1990-1992 (1996 values).

b/ Structure damage results in risk-based analyses are expressed as mean values. Standard deviations are not displayed.

a. Non-Levee Analyses. The non-levee hydrologic template was developed by Hydrologic Engineering Center for utilization in the evaluation of alternatives such as pumps and channels. In the Yazoo Backwater area, this spreadsheet was used to evaluate the flood damages prevented from various pump improvements. Non-levee analyses required the input of a design stage, representing the initial point of damage in each flood damage reach. The data were integrated with the stage-damage and stage-frequency relationships and their corresponding uncertainties in determining expected annual damages for each set of project conditions.

b. Levee Analyses. Preliminary structural alternatives proposed for possible implementation in the Yazoo Backwater area to alleviate flood damages include analyzing new levee improvements for the project area. The @Risk analyses, however, were not directly utilized on this alternative, since the Big Sunflower River levee is sized by the approximately 28-mile Yazoo Backwater levee system contained in documentation printed in House Document 359, 77th Congress. This levee system was completed in 1978 to an interim grade of 107.0 feet, National Geodetic Vertical Datum (NGVD). A standard URBAN (structure flood damage computer) analysis was completed to determine the damages remaining (flood damage prevented benefits) for the Big Sunflower River levees, identified as Yazoo Backwater initial array Plan 6.

Total Expected Annual Flood Damages to Structures

16. The results of preliminary risk-based analyses of structural damages in the Yazoo Backwater project area are summarized in Tables 7A-11 and 7A-12. Table 7A-11 compares the expected annual flood damages to built-up and rural areas for base (without-project) conditions to those with implementation of initial array Plan 2. Table 7A-12 presents the expected annual structural

flood damages for base (without-) and with-project conditions by project reach. With-project alternatives in the preliminary analysis included various-sized pumping plants, ranging from 10,500 cfs to 24,500 cfs (Initial Array Plans 1-5). Initial array Plan 6 represents the levee plan. Detailed descriptions of the array of alternative plans are included in the Main Report.

TABLE 7A-11
ANNUAL FLOOD DAMAGES TO BUILT-UP AND RURAL AREA STRUCTURES
ALL REACHES
BASE (WITHOUT-PROJECT) AND WITH-PROJECT CONDITIONS
BASED ON PRELIMINARY RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 Values)

Area/Year	Structural Annual Flood Damages ($000)	
	Base (Without-Project) Conditions	With-Project (Initial Array Plan 2) Conditions a/
Built-Up Area	110.0	10.0
Rural Area	1,962.0	271.0
Total Area	2,072.0	281.0

a/ Initial array Plan 2, 14,000-cfs pumping plant.

17. Structural annual flood damages for the built-up and rural areas of the Yazoo Backwater project area were cumulated into a total damage for all reaches. The resulting total structural annual flood damages are displayed in Table 7A-11 for the economic life of the project for base (without-project) and with-project conditions. With limits on content-to-structure value ratio of 50 percent and other limitations (no affluence factor and no projected population growth), flood damages to built-up and rural area structures for without- and with-project conditions are not projected to increase for future time periods. Thus, flood damages will remain constant over the expected economic life of the project.

TABLE 7A-12
ANNUAL STRUCTURAL FLOOD DAMAGES BY PROJECT REACH
WITHOUT- AND WITH-PROJECT CONDITIONS
BASED ON PRELIMINARY RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 Values)

Item	Structural Annual Flood Damages By Reach ($000) a/				
	Reach 1	Reach 2	Reach 3	Reach 4	Total Area
Without-Project Conditions					
Base (Existing) Flood Damages	1,465.0	196.0	249.0	162.0	2,072.0
With-Project (Initial Array) Conditions					
With-Project Flood Damages - Pumping Plant Alternatives b/					
Initial Array Plan 1, 10,500-cfs Pump	374.0	40.0	65.0	31.0	510.0
Initial Array Plan 2, 14,000-cfs Pump c/	213.0	19.0	36.0	13.0	281.0
Initial Array Plan 3, 17,500-cfs Pump	119.0	10.0	21.0	7.0	157.0
Initial Array Plan 4, 21,000-cfs Pump	81.0	8.0	13.0	5.0	107.0
Initial Array Plan 5, 24,500-cfs Pump	55.0	5.0	9.0	4.0	73.0
With-Project Flood Damages - Levee Alternative d/					
Initial Array Plan 6, Levee	144.0	3.0	96.0	76.0	319.0

a/ Output from preliminary risk-based analysis (1996 values).
b/ Results of the preliminary evaluation of various structural alternatives.
c/ Plan selected as structural feature for further analyses.
d/ Based on URBAN program results for the Big Sunflower River levee sized by the Yazoo Backwater levee system.

18. Expected annual flood damages to built-up and rural structures for base conditions were estimated to be approximately $2.1 million for the total project area (Table 7A-12). Remaining structural annual flood damages with the various alternative pump plans range from $73,000 for the 24,500-cfs pump to $510,000 for the 10,500-cfs pump. The levee alternative resulted in residual annual damages of $319,000.

PRELIMINARY STRUCTURAL BENEFIT ANALYSIS

19. Total benefits calculated in the preliminary risk-based structural analysis were combined with other damage or cost reduction benefits in determining the total project benefits utilized to select the structural feature for further analyses. Other benefit categories include agricultural crop, agricultural noncrop, catfish, road and bridge, emergency costs, flood insurance administration, and employment. Benefits for initial array Plan 2 are summarized in Table 7A-13 by built-up and rural area.

TABLE 7A-13
ANNUAL BENEFITS FROM INUNDATION REDUCTION TO STRUCTURES
WITH-PROJECT (INITIAL ARRAY PLAN 2) CONDITIONS
BASED ON PRELIMINARY RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
(7-5/8 Percent Discount Rate Analysis)
(1996 Values)

Year	Inundation Reduction Benefits to Structures ($000)		
	Built-Up Area	Rural Area	Total Area
1996 (Current Year) a/	100	1,691	1,791
2003 a/	100	1,691	1,791
2004	100	1,691	1,791
2005 b/	100	1,691	1,791
2006 (Base Year) c/	100	1,691	1,791
2015	100	1,691	1,791
2025	100	1,691	1,791
2035	100	1,691	1,791
2045	100	1,691	1,791
2055	100	1,691	1,791
Annual Benefits	100	1,691	1,791

a/ Construction of initial array Plan 2 estimated to be initiated in year 2003.
b/ EPCD (year project construction completed).
c/ Base year of project or first full year in which project benefits occur.

20. Total annual structural benefits, computed as the difference in the without- and with-project expected annual damages, are presented in Table 7A-14 for the preliminary alternative plans. Total project benefits to built-up and rural area structures in the Yazoo Backwater area ranged from approximately $1.6 million for the 10,500-cfs pump to nearly $2.0 million for the 24,500-cfs pump.

TABLE 7A-14
TOTAL ANNUAL BENEFITS FROM INUNDATION REDUCTION TO STRUCTURES
BY PROJECT REACH
INITIAL ARRAY OF ALTERNATIVE PLANS
BASED ON PRELIMINARY RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
(1996 Values)

Initial Array Alternative Plan	Inundation Reduction Benefits to Structures ($000) a/				
	Reach 1	Reach 2	Reach 3	Reach 4	Total Area
Pumping Plant Alternatives					
Plan 1, 10,500-cfs Pump	1,091	156	184	131	1,562
Plan 2, 14,000-cfs Pump	1,252	177	213	149	1,791
Plan 3, 17,500-cfs Pump	1,346	186	228	155	1,915
Plan 4, 21,000-cfs Pump	1,384	188	236	157	1,965
Plan 5, 24,500-cfs Pump	1,410	191	240	158	1,999
Levee Alternative					
Plan 6, Levee	1,321	193	153	86	1,753

a/ Output from preliminary risk-based analyses (1996 values).

SECTION 3 - RISK AND UNCERTAINTY ANALYSES - FINAL ARRAY OF ALTERNATIVE PLANS

21. Additional analyses were conducted for various options (with environmental considerations) formulated in the operation of the 14,000-cfs pump. These options comprise the final array of alternative improvement plans evaluated for the Yazoo Backwater area. (Detailed descriptions are included in the Main Report.) Risk-based analyses were performed on the final array of alternatives for each of the built-up and rural area reaches of the Yazoo Backwater area employing use of both the stage-damage and the non-levee @RISK templates. Methodology was the same as utilized in preliminary risk-based analyses.

STRUCTURAL FLOOD DAMAGE ANALYSIS - FINAL ARRAY OF ALTERNATIVE PLANS

22. The results of the stage-damage analyses for base (without-project) conditions of structural flood damages in the Yazoo Backwater area are presented in Table 7A-15 for each alternative in the final array by reach. Final array analyses were based on 1990-1992 structure inventories updated to current year, 2000 values.

Total Expected Annual Flood Damages to Structures

23. The results of risk-based analyses of structural damages in the Yazoo Backwater project area for the final array of alternatives are summarized in Tables 7A-16 and 7A-17. Table 7A-16 compares the expected annual flood damages to built-up and rural areas for base (without-project) conditions to those with the recommended plan (final array Plan 5). Table 7A-17 presents the expected annual structural flood damages for base (without-) and with-project conditions by project reach. With-project alternatives in the final array analysis are identified in Table 7A-17.

TABLE 7A-15
RESULTS OF THE STAGE-DAMAGE STRUCTURAL ANALYSES
BY PROJECT REACH
BASE (WITHOUT-PROJECT) CONDITIONS
BASED ON RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
(2000 Values)

Existing Structural Stage-Damage By Reach a/			
Flood Frequency Event	Stage (ft, NGVD)	Structure Damage ($000) b/	
		Built-Up Area	Rural Area
Reach 1			
1	87.0	0.0	8.6
2	91.0	0.0	169.7
5	94.6	8.2	2,103.7
10	96.3	75.8	4,221.7
25	98.0	321.7	7,447.4
50	99.2	721.6	10,804.6
100	100.3	1,442.0	14,782.2
Reach 2			
1	87.8	0.0	0.0
2	91.8	0.0	1.6
5	95.3	0.0	120.5
10	96.8	0.0	311.9
25	98.6	0.0	821.4
50	99.5	13.9	1,352.4
100	100.3	1,468.0	2,082.1
Reach 3			
1	87.8	0.0	7.9
2	91.8	0.0	87.2
5	95.3	0.0	280.1
10	96.8	0.0	745.8
25	98.6	0.0	1,317.1
50	99.5	0.0	1,642.8
100	100.3	0.0	1,946.4
Reach 4			
1	87.8	0.0	0.0
2	91.8	0.0	0.0
5	95.3	0.0	6.2
10	96.8	0.0	80.0
25	98.6	2.6	565.0
50	99.5	63.6	1,088.8
100	100.3	187.0	3,057.4

a/ Output from final array risk-based analyses based on structure surveys, 1990-1992 (2000 values).

b/ Structure damage results in risk-based analyses are expressed as mean values. Standard deviations are not displayed.

TABLE 7A-16
ANNUAL FLOOD DAMAGES TO BUILT-UP AND RURAL AREA STRUCTURES
ALL REACHES
BASE (WITHOUT-PROJECT) AND WITH-RECOMMENDED
(FINAL ARRAY PLAN 5) CONDITIONS,
BASED ON RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
(2000 Values)

Area/Year	Structural Annual Flood Damages ($000)	
	Base (Without-Project) Conditions	With-Recommended Plan Conditions a/
Built-Up Area	110.0	8.4
Rural Area	2,096.0	326.3
Total Area	2,206.0	334.7

a/ Alternative final array Plan 5, 14,000-cfs pumping plant with a year-round pump elevation of 87 feet, NGVD, at Steele Bayou.

24. In the final array analysis, structural annual flood damages for the built-up and rural areas of the Yazoo Backwater project area were cumulated into a total damage value for all reaches. The resulting total annual structural flood damages are displayed in Table 7A-16 over the economic life of the project for base (without-project) and with-project (recommended plan) conditions. As in preliminary analyses, flood damages are expected to remain constant for the 50-year economic project life.

25. Expected annual flood damages to built-up and rural structures for base conditions were estimated to be approximately $2.2 million for the total project area (Table 7A-17). Remaining structural annual flood damages with the various plans in the final array of alternatives range from $239,000 for Plan 3 to $567,000 for Plan 7. An analysis of the recommended plan (final array Plan 5) resulted in total structural flood damages of approximately $335,000 and a degree of protection of 85 percent.

TABLE 7A-17
ANNUAL STRUCTURAL FLOOD DAMAGES BY PROJECT REACH
WITHOUT- AND WITH-PROJECT CONDITIONS
FINAL ARRAY OF ALTERNATIVE PLANS
BASED ON RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
(2000 Values)

Item	Structural Annual Flood Damages By Reach ($000) a/				
	Reach 1	Reach 2	Reach 3	Reach 4	Total Area
Without-Project Conditions					
Base (Existing) Flood Damages	1,637.2	183.6	261.0	124.2	2,206.0
With-Project (Final Array) Conditions					
With-Project Flood Damages - 14,000-cfs Pump Alternatives b/					
Plan 3, Pump at 80 feet, NGVD	178.1	15.0	37.9	7.8	238.8
Plan 4, Pump at 85 feet, NGVD	199.4	17.6	44.9	9.4	271.3
Plan 5, Pump at 87 feet, NGVD c/	247.2	18.7	59.3	9.5	334.7
Plan 6, Pump at 88.5 feet, NGVD	312.2	21.2	75.5	8.9	417.9
Plan 7, Pump at 91/91.6 feet, NGVD	428.8	28.8	100.8	8.8	567.2

a/ Output from final array risk-based analyses (2000 values).
b/ Features results for the final array of alternative plans in the risk-based analysis (Plans 3 through 7) for the 14,000-cfs pump at various levels of pump operation. Plans 1 and 2 (not featured) were not evaluated in the risk-based framework. Plan 1 is the "no action" plan and Plan 2 represents a totally nonstructural plan.
c/ Recommended plan.

STRUCTURAL BENEFIT ANALYSIS -
FINAL ARRAY OF ALTERNATIVE PLANS

26. Total benefits calculated in the final array risk-based analyses were utilized in selecting the recommended plan. Dual consideration of economics and environmental concerns was reviewed in combination with engineering implementability. Total annual benefits were computed based on the difference in the base (without-) and with-project expected annual damages and are presented

in Table 7A-18 for the final array of alternative plans. Total project benefits to built-up and rural area structures in the Yazoo Backwater area ranged from approximately $1.6 million for Plan 7 to nearly $2.0 million for Plan 3. Benefits for the recommended plan (final array Plan 5) are summarized in Table 7A-19 by built-up and rural area.

TABLE 7A-18
TOTAL ANNUAL BENEFITS FROM INUNDATION REDUCTION TO STRUCTURES
BY PROJECT REACH
FINAL ARRAY OF ALTERNATIVE PLANS
BASED ON RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
(2000 Values)

Final Array Alternative Plan	Inundation Reduction Benefits to Structures ($000) a/				
	Reach 1	Reach 2	Reach 3	Reach 4	Total Area
Pumping Plant Alternatives					
Plan 3	1,459.1	168.6	223.1	116.4	1,967.2
Plan 4	1,437.8	166.0	216.1	114.8	1,934.7
Plan 5 b/	1,390.0	164.9	201.7	114.7	1,871.3
Plan 6	1,325.0	162.4	185.5	115.3	1,788.2
Plan 7	1,208.4	154.8	160.2	115.4	1,638.8

a/ Output from final array risk-based analyses (2000 values).
b/ Recommended plan.

TABLE 7A-19
ANNUAL BENEFITS FROM INUNDATION REDUCTION TO STRUCTURES
WITH-RECOMMENDED PLAN (FINAL ARRAY PLAN 5) CONDITIONS
BASED ON FINAL RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
(6-5/8 Percent Discount Rate Analysis)
(2000 Values)

Year	Inundation Reduction Benefits to Structures ($000)		
	Built-Up Area	Rural Area	Total Area
1996 (Current Year) a/	101.6	1,769.7	1,871.3
2003 a/	101.6	1,769.7	1,871.3
2004	101.6	1,769.7	1,871.3
2005 b/	101.6	1,769.7	1,871.3
2006 (Base Year) c/	101.6	1,769.7	1,871.3
2015	101.6	1,769.7	1,871.3
2025	101.6	1,769.7	1,871.3
2035	101.6	1,769.7	1,871.3
2045	101.6	1,769.7	1,871.3
2055	101.6	1,769.7	1,871.3
Annual Benefits	101.6	1,769.7	1,871.3

a/ Construction of recommended plan (final array Plan 5) estimated to be initiated in year 2003.
b/ EPCD (year project construction completed).
c/ Base year of project or first full year in which project benefits occur.

Project Effectiveness

27. Project effectiveness in the Yazoo Backwater area is indicated by examining the percentage reduction in damages provided by each plan. Table 7A-20 presents a summary of the percent

reductions provided by each of the final alternative plans evaluated. The recommended plan (final array Plan 5) would reduce base (existing) flood damages to structures in the Yazoo Backwater area by 85 percent. Overall, percentage reductions in existing flood damages to structures varied from 74 percent for Plan 7 to 89 percent for Plan 3.

TABLE 7A-20
PERCENT REDUCTION IN FLOOD DAMAGES TO STRUCTURES
FINAL ARRAY OF ALTERNATIVE PLANS
BASED ON RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
(%)

Final Array Alternative Plan	Percentage Reduction in Flood Damages to Structures				
	Reach 1	Reach 2	Reach 3	Reach 4	Total Area
Pumping Plant Alternatives					
Plan 3	89	92	85	94	89
Plan 4	88	90	83	92	88
Plan 5 a/	85	90	77	92	85
Plan 6	81	88	71	93	81
Plan 7	74	84	61	93	74

a/ Recommended plan.

SECTION 4 - FINAL RISK AND UNCERTAINTY ANALYSES

28. Final risk and uncertainty analyses were conducted on base (without-project) and with-project (recommended plan) conditions to incorporate updated structure inventories conducted in the spring of 2000 of the Yazoo Backwater project area. Both the stage-damage and the non-levee @RISK templates were utilized in the final risk and uncertainty evaluations. Methodology was the same as utilized in preliminary risk-based analyses.

FINAL STRUCTURAL FLOOD DAMAGE ANALYSIS

29. The results of the stage-damage analyses for base (without-project) conditions on structural flood damages in the Yazoo Backwater area are presented in Table 7A-21 for each reach. Final analyses were based on 2000 values.

Total Expected Annual Flood Damages to Structures

30. The results of final risk-based analyses of structural damages in the Yazoo Backwater project area are summarized in Table 7A-22. Table 7A-22 compares the expected annual structural flood damages for base (without-project) conditions to those with the recommended plan (final array Plan 5) by project reach. Final array Plan 5 represents the 14,000-cfs pump with a year-round pump elevation of 87 feet, NGVD, at Steele Bayou.

TABLE 7A-21
RESULTS OF THE STAGE-DAMAGE STRUCTURAL ANALYSES
BY PROJECT REACH
BASE (WITHOUT-PROJECT) CONDITIONS
BASED ON RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
(2000 Values)

Existing Structural Stage-Damage By Reach a		
Flood Frequency Event	Stage (ft, NGVD)	Structure Damage ($000)
Reach 1 (Includes Eagle Lake Built-Up Area)		
1	87.0	0.0
2	91.0	58.1
5	94.6	1,806.1
10	96.3	3,880.9
25	98.0	7,618.2
50	99.2	11,560.2
100	100.3	15,532.6
Reach 2 (Includes Cary and Rolling Fork Built-Up Areas)		
1	87.8	0.0
2	91.8	25.7
5	95.3	213.0
10	96.8	491.7
25	98.6	1,098.8
50	99.5	1,878.2
100	100.3	2,795.8
Reach 3		
1	87.8	0.0
2	91.8	6.4
5	95.3	469.1
10	96.8	1,155.4
25	98.6	1,772.0
50	99.5	2,111.6
100	100.3	2,388.2
Reach 4 (Includes Holly Bluff Built-Up Area)		
1	87.8	0.0
2	91.8	5.8
5	95.3	523.2
10	96.8	1,530.8
25	98.6	3,205.5
50	99.5	4,872.6
100	100.3	6,625.4

a/ Output from final risk-based analyses based on updated structure surveys conducted in the spring of 2000 (2000 values). Built-up areas were included in the reach in which they are located.

b/ Structure damage results in risk-based analyses are expressed as mean values. Standard deviations are not displayed.

31. In the final analysis, structural annual flood damages for each built-up and rural area of the Yazoo Backwater project area were cumulated into a total damage value for the reaches in which they were located. As in preliminary analyses, flood damages are expected to remain constant for the 50-year economic project life.

32. Expected annual flood damages for base (without-project) conditions were estimated to be approximately $2.6 million for the total project area (Table 7A-22). An analysis of the recommended plan (final array Plan 5) resulted in total structural flood damages of approximately $324,000 and a degree of protection of 87 percent.

TABLE 7A-22
ANNUAL STRUCTURAL FLOOD DAMAGES BY PROJECT REACH
WITHOUT- AND WITH-RECOMMENDED PLAN (FINAL ARRAY PLAN 5) CONDITIONS
BASED ON RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
(2000 Values)

Item	Structural Annual Flood Damages By Reach ($000) a/				
	Reach 1	Reach 2	Reach 3	Reach 4	Total Area
Without-Project Conditions					
Base (Existing) Flood Damages	1,470.5	221.4	327.8	560.6	2,580.3
With-Project (Recommended Plan) Conditions					
With-Project Flood Damages - 14,000-cfs Pump Alternative Plan 5, Pump at 87 feet, NGVD	185.9	31.5	43.5	63.3	324.2

a/ Output from final array risk-based analyses (2000 values).

FINAL STRUCTURAL BENEFIT ANALYSIS

33. Total project benefits from inundation reduction to structures in the Yazoo Backwater area for the recommended plan (final array Plan 5) are summarized in Table 7A-23 by project reach. Total annual benefits were computed based on the difference in the base (without-) and with-project expected annual damages. Total project benefits to structures from the recommended plan were determined to be approximately $2.3 million. Annual benefits from inundation reduction to structures for the recommended plan (final array Plan 5) are summarized in Table 7A-24 over the 50-year project life.

TABLE 7A-23
TOTAL ANNUAL BENEFITS FROM INUNDATION REDUCTION TO STRUCTURES
BY PROJECT REACH
RECOMMENDED PLAN (FINAL ARRAY PLAN 5)
BASED ON RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
(2000 Values)

Final Array Alternative Plan	Inundation Reduction Benefits to Structures ($000) a/				
	Reach 1	Reach 2	Reach 3	Reach 4	Total Area
Pumping Plant Alternatives					
Plan 5 b/	1,284.6	189.9	284.3	497.3	2,256.1

a/ Output from final array risk-based analyses (2000 values).
b/ Recommended plan.

TABLE 7A-24
ANNUAL BENEFITS FROM INUNDATION REDUCTION TO STRUCTURES
TOTAL PROJECT AREA
WITH-RECOMMENDED PLAN (FINAL ARRAY PLAN 5) CONDITIONS
BASED ON FINAL RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
(6-5/8 Percent Discount Rate Analysis)
(2000 Values)

Year	Inundation Reduction Benefits to Structures ($000)
1996 (Current Year) a/	2,256.1
2003 a/	2,256.1
2004	2,256.1
2005 b/	2,256.1
2006 (Base Year) c/	2,256.1
2015	2,256.1
2025	2,256.1
2035	2,256.1
2045	2,256.1
2055	2,256.1
Annual Benefits	2,256.1

a/ Construction of recommended plan (final array Plan 5) estimated to be initiated in year 2003.
b/ EPCD (year project construction completed).
c/ Base year of project or first full year in which project benefits occur.

Project Effectiveness

34. Project effectiveness of the recommended plan was determined by examining the percentage reduction in damages provided by improvements. Table 7A-25 presents a summary of the percent reductions provided by the recommended plan for each project reach in the Yazoo Backwater area. The recommended plan (final array Plan 5) would reduce base (existing) flood damages to structures in the total Yazoo Backwater area by 87 percent. Overall, percentage reductions in existing flood damages to structures ranged from 86 percent for Reach 2 to 89 percent for Reach 4.

TABLE 7A-25
PERCENT REDUCTION IN FLOOD DAMAGES TO STRUCTURES
RECOMMENDED PLAN (FINAL ARRAY PLAN 5)
BASED ON RISK AND UNCERTAINTY ANALYSES
YAZOO BACKWATER AREA, MISSISSIPPI
(%)

Final Array Alternative Plan	Percentage Reduction in Flood Damages to Structures				
	Reach 1	Reach 2	Reach 3	Reach 4	Total Area
Pumping Plant Alternatives					
Plan 5 a/	87	86	87	89	87

a/ Recommended plan.

ATTACHMENT 7B

AGRICULTURAL RISK AND UNCERTAINTY ANALYSES

GENERAL

1. Risk and uncertainty are intrinsic values in water resources planning and design. These values arise from measurement errors and from the inherent variability of complex physical, social, and economic situations. Agricultural analyses of proposed water resources projects contain unique risks and uncertainties that arise from numerous variables and complex independent and dependent relationships. Determining the "true" values of all the variables and relationships to derive a single mean value (average value) is an ambitious, if not impossible, undertaking. By incorporating risk and uncertainty into the agricultural analyses, a complete display of all possible outcomes can be derived along with the expected mean or average value. The results reflect a range of values (variation) with the relative likelihood of occurrence.

2. The economic evaluation of the Yazoo Backwater Area was conducted utilizing the risk analyses procedures described in Engineer Circular 1105-2-205, dated 25 February 1994, and the Principles and Guidelines for Water Resources Planning, Engineer Regulation 1105-2-100. These procedures, along with traditional methodologies, were chosen as the most effective means of evaluating the uncertainty in agricultural analyses. To grasp the incorporation of agricultural risk and uncertainty, it is meaningful to first understand the traditional agricultural analyses procedures and relationships involved. The following section is an overview of traditional agricultural analyses.

TRADITIONAL AGRICULTURAL ANALYSES

3. The traditional analyses involve gathering pertinent data, applying an agricultural flood damage model, determining average annual acres flooded, projecting damages, and comparing

without- and with-project conditions, as also described in previous paragraphs. The following tasks and evaluations are essential to assess existing conditions and estimate conditions with the installation of proposed water resources improvements.

a. Determine present and future without- and with-project cropping patterns, crop distributions, farming practices, yields, and gross and net returns per crop. These data are derived from surveys of area farmers, extension agents, agronomists, soil scientists, Federal Crop Reporting Service personnel, and other local, state, and Federal agricultural personnel.

b. Develop area-specific crop budgets for without- and with-project conditions. Current State of Mississippi extension crop budgets are adjusted by the area-specific data described in the Economic Analysis Appendix.

c. Derive daily routings data (historical period-of-record hydrologic data and flooded acres on a daily basis) for without- and with-project conditions. The entire flood history is applied, which, in this analysis, records 55 years of daily historical stages. Time of year (i.e., seasonality) of flooding is critical to more accurately estimate crop damages.

d. Calculate per-acre flood damages for without- and with-project conditions. A computer model developed jointly by the Department of Agricultural Economics, Mississippi State University, and the U.S. Army Corps of Engineers, Vicksburg District, to quantify agricultural crop flood losses was employed. The Computerized Agricultural Crop Flood Damage Assessment System (CACFDAS) utilizes historical daily flood routing data, current budget data, present cropping patterns and production techniques including replanting and substitution, as well as other relevant data to assess damages to crops. Output from the CACFDAS program includes acres flooded for the historical period, total damage by crop, and damage per-acre flooded. (Refer to the Economic Analysis Appendix for a description of the CACFDAS program for a more detailed explanation of program output.)

e. Determine the average annual cleared acres flooded for without- (existing) and with-project conditions. Average annual acres flooded are determined through integration of elevation-area (stage-area) flooded and partial duration elevation-frequency (stage-frequency) curves and computation of the area contained by the resulting area flooded-frequency curve.

f. Compute agricultural benefits from a proposed water resources plan of improvement. Two categories of agricultural benefits exist: flood damage prevented (inundation reduction) benefits derived from the reduction in flood damages, and intensification benefits that occur when a plan enables improved utilization of the land and increases net income. Numerous acreage and other adjustments are made during the computation of agricultural benefits. Some of these adjustments include adjustments to appropriately account for farmed wetland acreage, low-lying cleared acreage, and other land removed from production; adjustment to exclude land in the Conservation Reserve Program; the Wetlands Reserve Program; and adjustments to net returns per acre.

AGRICULTURAL RISK AND UNCERTAINTY ANALYSES

4. It is evident from the data presented above that numerous variables and complicated relationships are involved in the procedures necessary to quantify existing agricultural crop flood losses and proposed plan improvement benefits. Although detailed and thorough area-specific data enumerations were conducted, state-of-the-art computer models applied, and utilization of knowledge of scores of agricultural experts, uncertainties remain. (Perfect knowledge is never obtainable.) The application of risk analyses in the evaluation of agricultural benefits is not only the acknowledgement of these uncertainties, but the willingness to quantify these uncertainties.

5. With new technology, including the computer software program @Risk, economists along with hydrological experts can deal statistically with the risk and uncertainty that was previously not attempted in traditional agricultural flood damage analyses. Risk-based analyses incorporate risk and uncertainty into the calculation of agricultural damages by using a simulation technique in which multiple iterations select from the full range of possible values for selected key

variables utilized in the computation of proposed plan benefits. The resulting mean (average) value and probability distributions provide the decision maker (customer) with a more complete analogy of possible results.

6. The analyses are accomplished by considering the range of possible values (maximum and minimum values for each selected input variable in the flood damage calculation) and distribution of the occurrence of outcomes over the specified range. The @Risk program uses Monte Carlo simulation to derive the possible occurrences. Monte Carlo simulation utilizes randomly generated numbers to simulate the occurrences of selected variables from established ranges and distributions. In a normal distribution, 68 percent of the occurrences of a specified result would be within one standard deviation (on either side) of the mean or expected value, 95 percent within two standard deviations (on either side) of the mean, and 99.7 percent within three standard deviations (on either side) of the mean.

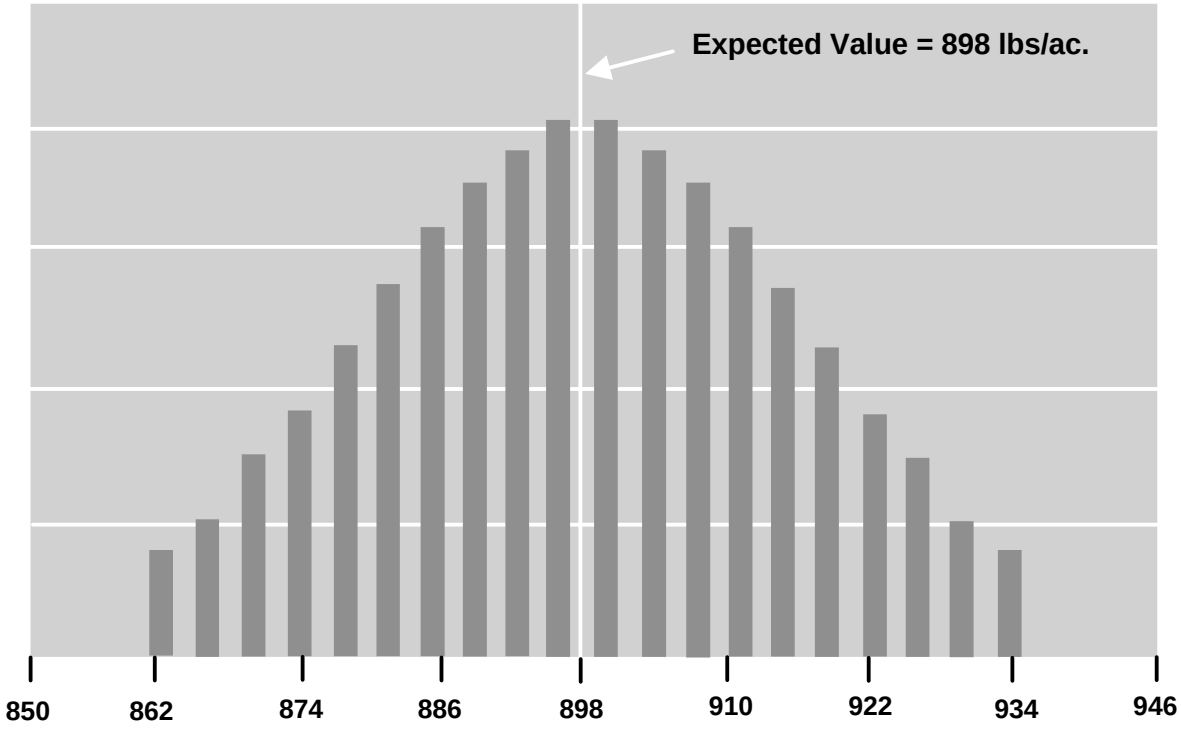
7. The computerized Latin Hypercube sampling technique is utilized to sample from within the range of values. With each sample or iteration, a value is selected from the random number generator system contained within the computer. For example, if mean cotton yield of 898 pounds is allowed to vary plus or minus 5 percent, the first sample may be 919 pounds, the second sample 876 pounds, etc. (Figure 7B-1). The range of potential values can vary from a minimum of 853 pounds to a maximum of 943 pounds, with each specific iterative value determined by the random number generator system. Each value is utilized through the total computational process to derive the proposed project benefits. The sum of all sampled values divided by the number of samples yields the expected mean value. This routine is accomplished simultaneously for each of the variables evaluated for its inherent uncertainty.

8. The risk and uncertainty analysis includes not only the mean estimate that is the expected result (or the most likely occurrence of a variable), but also the range of potential outcomes for that variable and the distribution of potential outcomes over that range. The results reflect the magnitude of rare and unlikely combinations of possible values that affect project formulation.

FIGURE 7B-1

COTTON YIELD UNCERTAINTY

REACH 1 : PLAN 2
YAZOO BACKWATER AREA



Iteration	Value W/R&U
1	919
2	876
3	902
.	.
.	.
5,000	910
Total	4,490,000

5,000 = 898

9. Some of the key variables in agricultural flood damage reduction evaluations include crop yields, production cost, crop distributions, seasonality of flooding, plant yield loss due to flooding, crop prices, and crop acres flooded. Crop yields and the damage per acre flooded value from the CACFDAS program were selected to evaluate the risks and uncertainties within this agricultural evaluation. These two variables capture a large portion of the uncertainty in quantifying agricultural damages and benefits. The variability of yields for both without- and with-project conditions is a key component in calculating crop damages and benefits. The damage per acre flooded value generated by the CACFDAS program encompasses crop distributions, crop budgets, substitution of alternative crops, damage-duration data, daily historical hydrologic data, and other physical and economic relationships.

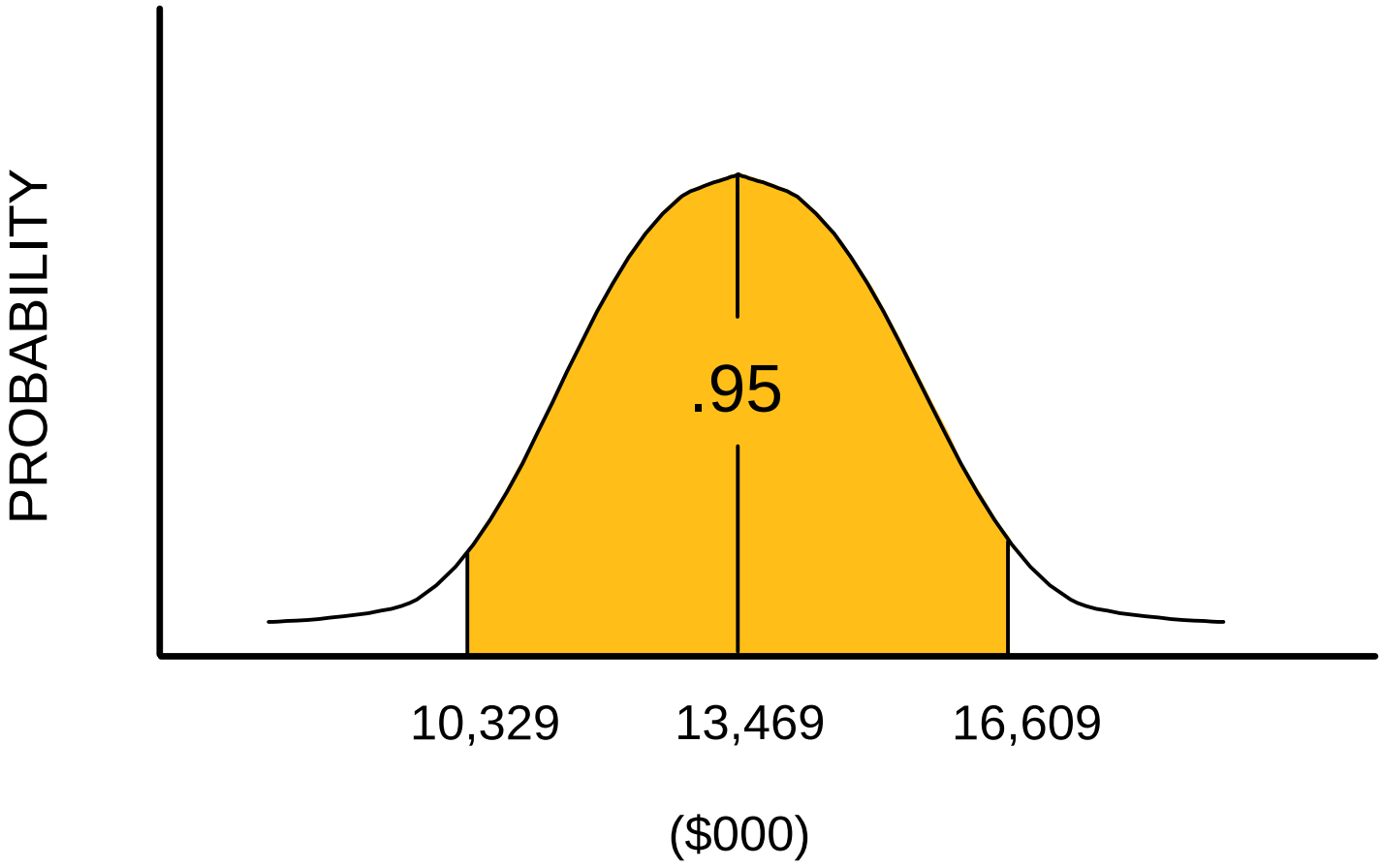
10. Figure 7B-1 displays a schematic diagram of the results of risk and uncertainty modeling from calculating per acre cotton yield. A normal distribution is depicted with a sample mean value (survey value) of 898 pounds, standard deviation of 22.9 pounds, and a range plus or minus 5 percent. Assuming a 95 percent confidence level exists in this sample, the true mean is within plus or minus 5 percent of the sample mean. This example produces a standard deviation for per-acre cotton yield of 22.9 pounds (44.9/1.96). The uncertainty of the flood damage per acre value from the CACFDAS program is also evaluated and integrated with the other variables to determine total damages and benefits and their corresponding uncertainty, assuming the uncertainty of all the variables.

11. Figure 7B-2 displays an example of the results of benefits derived from incorporating the uncertainties of crop yields and the flood damage per acre values from the CACFDAS program for initial array Plan 2. A normal distribution results with a sample mean value of $13,469,000, and a standard deviation of $1,570,000. Also, the benefit probability distribution of the National Economic Development Plan implies 95 percent confidence that the expected annual benefit would be within the range of $10,329,000 and $16,609,000.

FIGURE 7B-2

EXPECTED BENEFITS

INITIAL ARRAY PLAN 2
95 PERCENT CONFIDENCE INTERVAL
YAZOO BACKWATER AREA



EXPECTED ANNUAL BENEFITS = $13,469

STANDARD DEVIATION = $1,570

FINAL ANAYSIS

RECOMMENDED PLAN

12. The final analysis of agricultural flood benefits used the same methodology applied to the traditional agricultural analysis to determine the risk and uncertainty associated with Reach 1 of the recommended plan. The results yielded a mean value of $7,473,000 and a standard deviation of $465,000 (Figure 7B-3). In addition, the benefit probability distribution of the recommended plan implies 95 percent confidence that the expected annual benefit would be within the range of $6,543,000 and $8,403,000. This same level of variability would be applicable to each of the other three reaches.

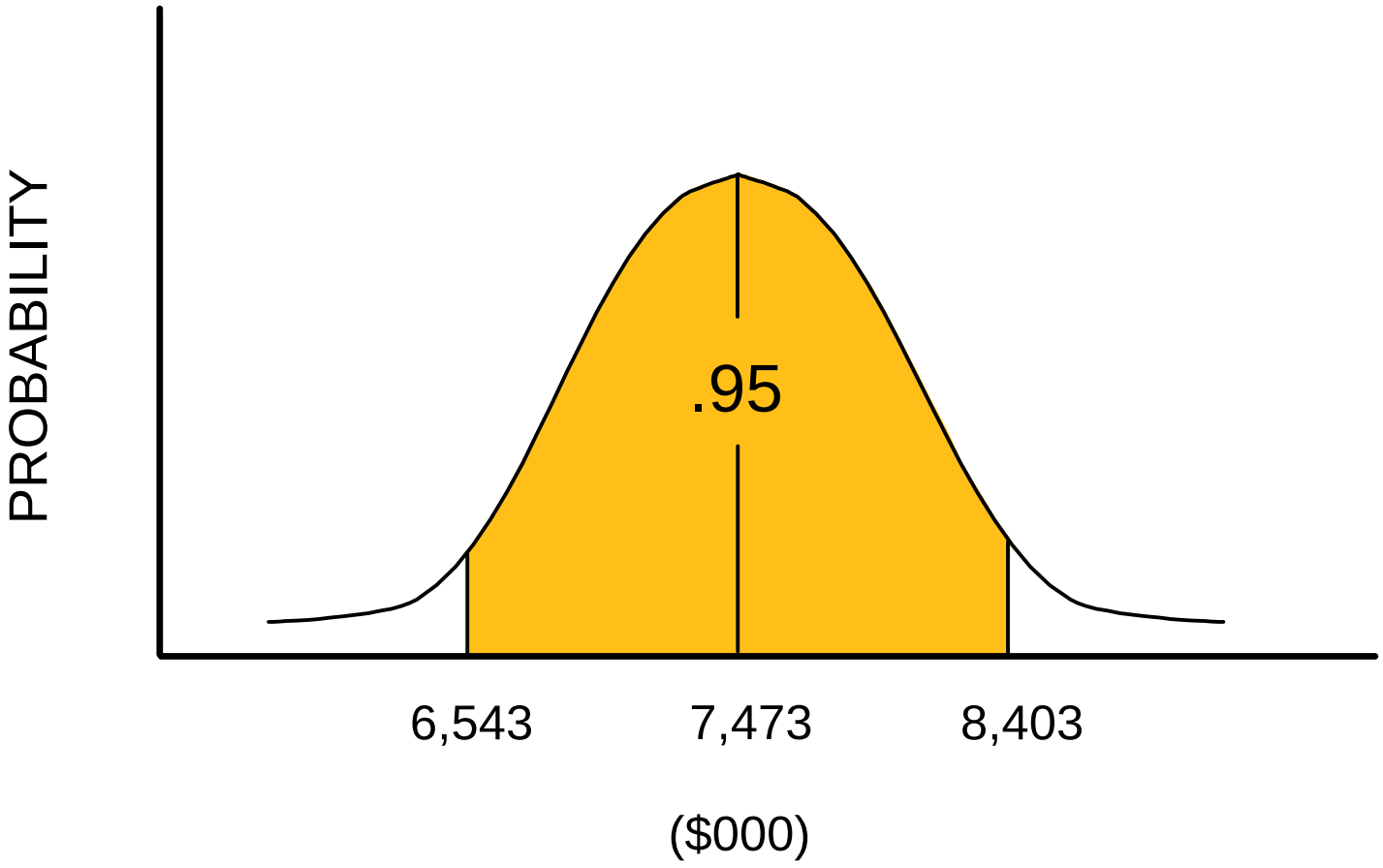
13. Figure 7B-4 illustrates the benefits to Reach 1 of the recommended plan and corresponding probabilities derived within the risk and uncertainty framework. The results of the risk and uncertainty analyses indicate that the overall benefits derived for Reach 1 of the recommended plan has an 87 percent probability of being equal to or greater than $7,000,000.

14. It should be emphasized that no technique, including the traditional methods and risk-based analysis procedures, can determine an absolutely accurate result or decision. These techniques are tools that are used to assist in making decisions and deriving solutions. Hindsight is as close to perfection as can be obtained when data are involved, which are not available at the time a decision needs to be made. However, with these well-researched and developed procedures, models, and techniques, the assumption can be made that the optimum plan has been selected, provided the information available and the reliability of the values utilized in the modeling.

FIGURE 7B-3

EXPECTED BENEFITS

RECOMMENDED PLAN
95 PERCENT CONFIDENCE INTERVAL
YAZOO BACKWATER AREA



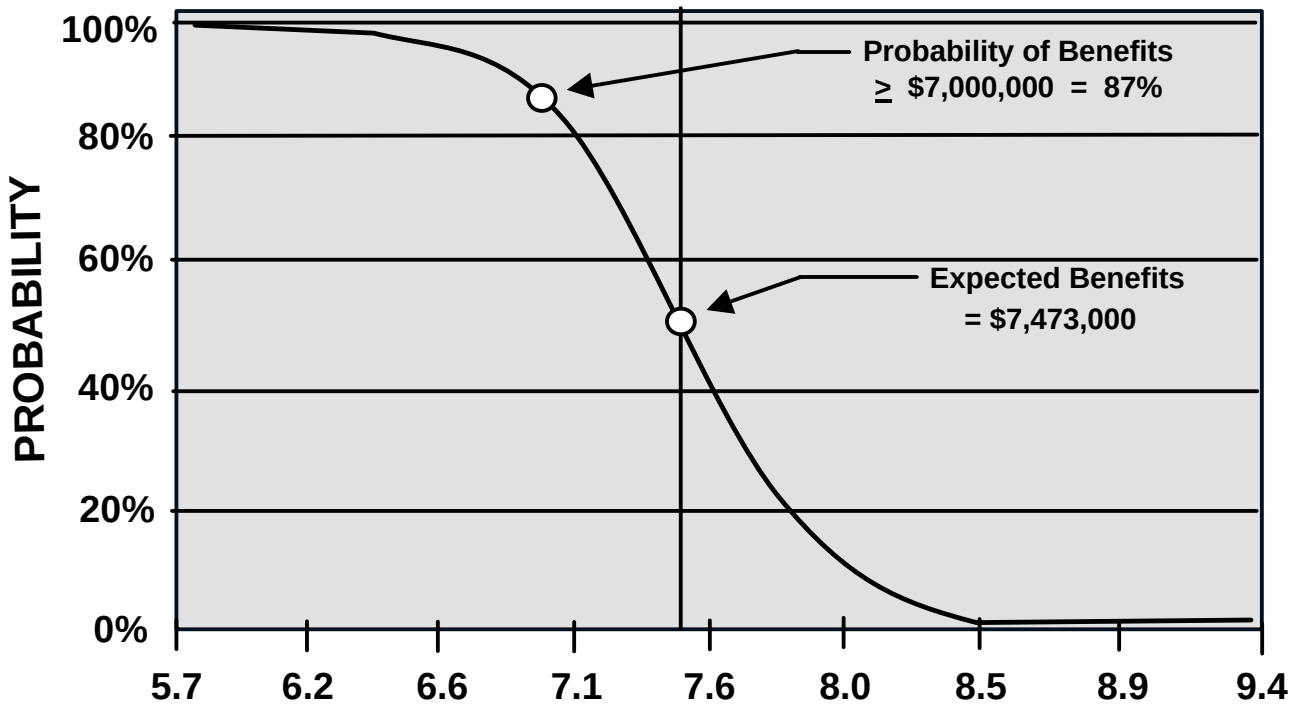
EXPECTED ANNUAL BENEFITS = $7,473

STANDARD DEVIATION = $465

FIGURE 7B-4

EXPECTED BENEFITS PROBABILITY

RECOMMENDED PLAN
YAZOO BACKWATER AREA



EXPECTED BENEFITS = $7,473,000

ATTACHMENT 7C
ASSESSMENT OF IMPACTS AND EVALUATION OF DETAILED STRUCTURAL PLANS

INTRODUCTION

GENERAL

1. This section contains information pertaining to the assessment, display, and accounting of economic, environmental, and social impacts of an implementable water resources improvement plan (recommended plan) for the Yazoo Backwater project area. The project area is located in northwest Mississippi and is located in or affects portions of six counties in the Yazoo River Basin of west-central Mississippi. These include Humphreys, Issaquena, Sharkey, Warren, Washington, and Yazoo Counties in Mississippi and a small portion of Madison Parish in Louisiana. Two of these counties (Issaquena and Sharkey) are totally encompassed by the project study area. The Big and Little Sunflower Rivers, Deer Creek, and Steele Bayou are the major streams in the Yazoo Backwater project area. Information presented describes and assesses the beneficial and adverse impacts from implementation of the recommended plan identified for various components of the human and natural environment pursuant to existing regulations and guidelines.

2. An impact assessment was conducted to identify and describe the economic, social, and environmental impacts expected from implementation of the recommended plan. Environmental features are included to enhance fish and wildlife resources. These evaluations form the basis for assessing the overall beneficial and adverse contributions of the project. The assessment and evaluation of plan impacts (economic, environmental, and social) are presented for the recommended plan. The difference in each pertinent parameter between the without- and with-project condition is the impact of the plan. Significance of impacts was determined when

specific impact situations were considered crucial to decision making. Specific parameters (required by Section 122 of the 1970 River and Harbor and Flood Control Act, Public Law 91-611) were included and evaluated; other impacts were included if significant.

3. Display of the assessment of plan impacts is facilitated by the Systems of Accounts format. Four accounts, the NED, Environmental Quality (EQ), Regional Economic Development (RED), and Other Social Effects (OSE), are used in organizing the information on impacts. These four accounts encompass all significant plan effects on the human environment as required by the National Environmental Policy Act (NEPA) of 1969 and on social well-being as required by Section 122 of the River and Harbor and Flood Control Act of 1970 (Public Law 91-611). These four accounts are also discussed in ER 1105-2-100, 28 December 1990, paragraph 5-8, page 5-14. The NED account presents effects on the national economy by reflecting the monetary changes in the net value of the national output of goods and services. The EQ account presents effects on ecological, cultural, and esthetic attributes of significant natural and cultural resources that are immeasurable in monetary terms. The RED account presents the regional incidence of NED effects, income transfers, employment, and other effects. The OSE account presents the urban and community impacts and effects on life, health, and safety. The Systems of Accounts format is integral to the planning process and provides information in trade-off analysis and decision making.

INCIDENCE OF PROJECT IMPACTS

4. The location, timing, and duration of each significant impact are also presented.

a. Location. Impacts are described to identify the geographic location of expected occurrence.

b. Timing. The timing of impacts is identified to establish their implementation.

c. Duration. The duration of impacts is identified to determine the extent and amount of any irreversible or irretrievable commitments of resources and their duration.

ACCOUNT VALUES

5. Systems of Accounts values for the various impact parameters are presented in monetary terms where possible; otherwise, quantitative units or qualitative terms are used. Monetary values in the accounts were converted to annual amounts by applying standard discounting procedures.

ALTERNATIVE CANDIDATE PLANS (BASE NED PLAN AND RECOMMENDED PLAN)

Base NED Plan

6. The NED plan (Base NED plan) is the plan which provides the maximum amount of net benefits (excess benefits over costs). In the economic analyses conducted for the detailed alternative structural plans, Alternative Plan 3 is the plan which provides the greatest amount of net benefits. Additional information concerning the base NED plan is contained in Appendix 7, Economic Analysis.

Recommended Plan

7. The recommended plan consists of a 14,000-cubic-foot-per-second (cfs) pumping plant with an 87-foot, National Geodetic Vertical Datum (NGVD), operating elevation and nonstructural flood control below 87 feet, NGVD. Additional information concerning the recommended plan is presented in Appendix 7 (Economic Analysis) and in the Main Report.

DETAILED ALTERNATIVE STRUCTURAL PLANS

8. Various detailed alternative structural, nonstructural, and combination structural/ nonstructural alternative flood control plans considered or evaluated for the Yazoo Backwater project area are discussed in the Main Report.

9. Seven detailed alternative structural, nonstructural, and combination structural/nonstructural plans were evaluated in the Economic Analysis, Appendix 7, of this report. With the selection of a recommended plan, this plan was utilized to provide the refined costs/benefits presented as the recommended plan.

10. Implementation of the recommended plan for the Yazoo Backwater project area will involve a 14,000-cfs pumping plant with an 87-foot, NGVD, operation, and nonstructural flood control below 87 feet, NGVD. Project implementation/construction will require the acquisition by easement of 62,500 acres below the elevation of 87 feet, NGVD. These easements will be acquired from willing sellers. No structural flood control will be provided below the elevation of 87 feet, NGVD. Lands below the elevation of 87 feet, NGVD, will be protected through the reestablishment of wooded lands which are more compatible to the frequent flooding that occurs at these lower elevations.

11. Implementation of the recommended plan in the Yazoo Backwater project area will require the acquisition from willing sellers of easements on 62,500 acres of agricultural cropland. Reestablishment of wooded lands on these open croplands will provide enhancement to the project area environment. All of the easement lands will be taken out of crop production and will be reforested with bottom-land hardwoods to create wildlife habitat.

CONSTRUCTION PROCEDURE AND PROJECT OPERATION AND MAINTENANCE, RECOMMENDED PLAN

Construction

12. Construction of the recommended plan is estimated to require 3years (2004-2006). Approximately 25 percent of the total construction costs, including costs for easement acquisition and other associated costs for nonstructural features, would be expended the first year, 40 percent the second year, and 35 percent the third year.

13. Implementation of the recommended plan in the Yazoo Backwater project area will consist of two primary features: (1) 14,000-cfs pumping plant and (2) nonstructural flood control below 87 feet, NGVD, by reestablishment of hardwood forests on open cropland.

Project Operation and Maintenance

14. The U.S. Army Corps of Engineers, Vicksburg District, is responsible for 100 percent of the operation and maintenance of the Yazoo Backwater project. Structure maintenance was estimated on all structures annually with no major replacement necessary for the life of the project.

IMPACT ASSESSMENT PROCEDURE

GENERAL

15. Installation of the recommended plan in the Yazoo Backwater project area will impact the economic, environmental, and social structure of the economic base study area. This section of the Impact Assessment and Systems of Accounts presentation addresses potential impacts to

these parameters from construction and operation of the recommended plan for the project area. The project impact will change between the construction and postconstruction periods; some impacts will be temporary, while others will have lasting impacts. Project impacts would also be realized in the remainder of the nation.

16. Project impacts and other useful information in decision making are presented in the Main Report and discussed in the Systems of Accounts of this appendix. The Main Report presents a summary of critical and determinative information useful in the plan selection/decision-making process. This appendix provides detailed information highlighting assessed impacts and displaying the beneficial and adverse impacts of the recommended plan in terms of NED, EQ, RED, and OSE account contributions. Throughout the discussion and presentation, the following definitions apply:

a. Project area. Includes construction sites and lands within the identified area impacted by the Yazoo Backwater project (i.e., the area subject to flooding by a 100-year frequency flood event).

b. Study area/economic base area. Includes Humphreys, Issaquena, Sharkey, Warren, Washington, and Yazoo Counties, Mississippi, except where noted (Plate 4-1).

c. Rest of nation. Area of the United States, excluding the study area.

d. Parameter. A component of man's environment which, when changed, directly contributes to or detracts from the accomplishment of a planning objective or quality of life.

ECONOMIC PARAMETERS

National Economic Development (NED)

17. NED concerns change in the national output, an output partly reflected in a national product and income accounting framework designed to measure the flow of goods and services in the economy. The component parts of NED evaluated are the value to users of outputs of goods and services (benefits) and the value of resources required (costs) for a plan. The economic costs and benefits, expressed in terms of NED, and efficiency, expressed in terms of net benefits, are used as the standard of evaluation. Based on data developed during the economic analysis, the beneficial and adverse impacts associated with NED will be distributed throughout the project area, study area, and the rest of the nation, as presented in the Systems of Accounts table of this appendix.

18. Total NED benefits of the recommended plan are estimated to be $17,918,000 annually for the recommended plan (excludes employment benefits) at the current fiscal year 2000 Federal discount rate of 6-5/8 percent. Employment benefits ($506,000 annually) will accrue to the study area from project construction due to the creation of jobs and income flows and reduction of unemployment and underemployment in the construction industry. This can also contribute to increased incomes of persons in associated industries.

19. Total costs ($14,881,000 annually) include the value of resources required for project construction and operation and maintenance. Annual project costs were assessed to the rest of the nation in accordance with annual project costs designated as Federal costs and are presented in the Systems of Accounts.

Regional Economic Development (RED)

20. Income. Income impacts can be derived by summarizing the various NED benefits. In addition to the induced regional impacts, study area personal incomes would be increased by expenditures made by construction forces and subsequent second and third round expenditures. Area income and employment would be stimulated from project construction. For example, there would be increased demand for inputs used in construction; increased demands for food, clothing, and shelter induced by the influx of construction labor; and increased purchasing power of any locally hired labor. Money expended for wages and salaries has the impact of being spent several times in the local economy (the multiplier effect).

21. Employment/Labor Force.

a. Construction of the recommended plan would require an estimated 1,000 construction workers, consisting of an estimated 48 percent skilled, 24 percent semiskilled, 8 percent unskilled, and approximately 20 percent supervisory and administrative personnel. Project construction and operation and maintenance of the completed project are expected to have limited impact on employment in the study area as effects will be temporary, occurring only during the 5-year construction period.

b. Some related impacts to area employment from project construction will also occur. Temporary impacts in employment in various area industries/firms can be expected during project construction.

22. Business and Industrial Activity. Existing business and industrial activity within the study area economy will be stimulated during project construction; increases will be temporary.

23. Local Government Finances. Public revenues and expenditures could be significantly affected by implementation of a flood control project. These effects would be reflected by decreases in property taxes collected by the counties under current conditions. As lands are converted from agricultural lands to wooded lands, property taxes are reduced. Legislation is pending at the state level that could offset these potential losses to the counties. These reductions, if not recovered by some other means, could cause reductions in local government incomes and expenditures.

a. Tax revenues/rates. Project implementation could result in decreases in tax revenues through taxation of property with decreased value since the lands would convert from crop to woods. This change in use would have the effect of reducing taxes due on the lands converted to woods. Any increased taxes levied against area residents/landowners would be viewed adversely in terms of general public attitude.

b. Public facilities/services. Project impacts on existing public services and facilities in most of the four built-up areas within the Yazoo Backwater project area are expected to be negligible, since the influx of construction employees will be concentrated at the site of the pump construction. Requirements for services and facilities such as utilities, telephones, schools, etc., can be provided by the local area for base (without-project) conditions. Services presently provided by utility and local governmental organizations should be adequate in both quantity and quality.

24. Property Values. Project implementation is expected to create beneficial impacts on property values, in the protected flood plain.

25. Regional Growth (Desirable). Desirable regional growth refers to the rates of economic and population growth of a region that are consistent with publicly defined objectives. Throughout the Yazoo Backwater project area, publicly defined objectives, explicit or implied, include economic growth.

26. Displacement of Farms. Implementation of the recommended plan will not result in displacement of farms in the project area. It is expected that impacted owners have sufficient acreage in their farms such that land requirements of project construction and reforestation would not adversely impact the overall/total farming operations. Implementation of the recommended plan will necessitate acquisition of easements on 62,500 cropland acres from willing project area landowners. Easements for cropland acres to be protected by nonstructural measures will be acquired from willing sellers. A total of 62,500 acres of cropland will be removed from crop production and will be reforested with bottom-land hardwoods for wildlife habitat and timber production.

ENVIRONMENTAL PARAMETERS

Environmental Quality (EQ)

27. Natural Resources. Natural resources affected by implementation of the recommended plan would include land areas, water areas, and streams of the project area and associated fish, wildlife, waterfowl resources, and mineral resources. These areas provide recreational, water quality, esthetic, wildlife, and intrinsic benefits to the human environment. Specific significant resources include prime farmlands, waterfowl, bottom-land hardwoods, wetlands, threatened and endangered species, and cultural resources. Principal mineral resources in the Yazoo Backwater project area include sand, gravel, and clay. Sand and gravel resources, which are numerous and widespread through the area, are the most important mineral resources in the area. They are utilized in the construction industry as well as in the glass production and molding industries. Clays, used in making bricks, are also an important area resource. Sixty-four percent of the Yazoo Backwater project area lands are dedicated to agriculture.

a. Land resources. No additional acreage is required for actual construction of the recommended pumping plant. The reforestation portion of the plan will require easements on 62,500 acres of cleared lands. Converting existing crop land use to bottom-land hardwoods will provide significant beneficial impacts to area wildlife resources, since existing bottom-land hardwoods in the area are limited. These lands will be retained in bottom-land hardwoods in perpetuity. Beneficial and adverse impacts on easement areas are monetized and displayed in the NED account.

b. Wetland resources. In addition to their very important wildlife value, project area wetlands provide floodflow alteration, sediment and toxicant retention, nutrient removal, and transformation, sediment stabilization, and production export (reference Appendix 12). Hydric soils were used to delineate agricultural (identified by NRCS as farmed wetlands or prior converted wetlands) and bottom-land hardwood wetlands (reference Appendixes 7 and 12). NRCS-identified farmed wetlands and prior-converted cropland are lands cropped before 23 December 1985. Farmed wetlands currently possess wetland functions and experience at least 15 consecutive days of growing-season inundation unlike prior-converted wetlands. Accordingly, prior-converted croplands are not regulated by Section 404 of the Clean Water Act. Agricultural and bottom-land hardwood wetlands total 48,532 average daily acres within the 2-year flood frequency (Table 7C-1 and reference Appendix 12). Bottom-land hardwoods account for 72 percent and farmed wetlands 28 percent of these existing wetlands. Extensive farm drainage systems and the lack of frictional resistance on farmed wetlands create a lower probability of performing wetland functions than bottom-land hardwoods. With implementation of the recommended plan, there would be a 23.5 percent gain in functional wetland value.

TABLE 7C-1
COMPARATIVE IMPACTS OF ALTERNATIVES a/
YAZOO BACKWATER PROJECT
(RECOMMENDED PLAN IS PLAN 5)

Alternative	Terrestrial Resources b/	Aquatic Resources c/	Wetland Resources d/	Waterfowl Habitat e/	Water Quality	Endangered Species
No Action Plan 1	Existing conditions will continue. 233,869 acres of bottom-land hardwood habitat.	Existing conditions will continue. 72,316 acres of 2-year average seasonal flooded acres.	Existing conditions will continue. 35,134 average daily bottom-land hardwood acres within the 2-year flood frequency and 13,398 average daily farmed wetland acres within the 2-year flood frequency.	Existing conditions will continue. 9,138 acres of average seasonal habitat available.	Existing conditions will continue. No direct impacts. Degraded water quality would continue.	Not applicable.
Plan 2	28.4 percent increase in terrestrial habitat. Net gain of 175,542 AAHU's. Reforestation of 107,000 acres of frequently flooded agricultural land.	40 percent increase in flood plain spawning habitat or 80,072 HU's. Reforestation of 107,000 acres of frequently flooded land.	41.5 percent increase of forested wetlands functional value or 77,919 FCU's. Reforestation of 107,000 acres of frequently flooded agricultural land.	39.8 percent reduction in waterfowl foraging habitat value or 824,505 DUD's. Reforestation of 107,000 acres of frequently flooded agricultural land.	Conditions should improve with the reforestation of 107,000 acres of agricultural land.	Reforestation of 107,000 acres will provide additional habitat for the endangered pondberry plant (*Lindera melissifolia)* and threatened Louisiana black bear (*Ursus americanus luteolus*).
Plan 3	1.1 percent reduction in terrestrial resource value or 6,680 AAHU's. 38 acres of bottom-land hardwoods converted or a loss of 108 AAHU's. Hydrologic loss of 6,572 AAHU's on bottom-land hardwoods. Requires compensatory mitigation of 38 acres of frequently flooded agricultural lands.	31.8 percent reduction in flood plain spawning habitat value or 63,886 HU's. 38 acres of bottom-land hardwoods converted or a loss of 142 HU's. Hydrologic loss of 63,744 HU's on various habitats. Requires compensatory mitigation of 27,435 acres of frequently flooded agricultural land.	24.3 percent loss of wetland functional value or 53,251 FCU's. 38 acres of bottom-land hardwoods and 110.5 acres of farmed wetlands converted or a loss of 463 FCU's. Hydrologic loss of 52,788 FCU's. Requires compensatory mitigation of 23,001 acres of frequently flooded agricultural lands.	9.2 percent loss of waterfowl foraging habitat value or 191,100 DUD's. Direct loss of 38 acres of bottom-land hardwoods or 2,166 DUD's. Hydrologic loss of 188,934 DUD's of waterfowl foraging habitat value. Requires compensatory mitigation of 1,613 acres of frequently flooded agricultural lands.	Construction of structural features will cause a short-term increase in turbidity. Reforestation of 27,435 acres of agricultural land will improve water quality over time.	An on-ground survey and biological assessment for *Lindera melissifolia* and *Ursus americanus luteolus* were completed. No colonies of pondberry were found in rights-of-way and no signs of Louisiana black bear were found. Biological assessment concludes that the project is not likely to adversely affect either species. No indirect or hydrologic impacts on either species. Reforestation of 27,435 acres will provide additional habitat.

TABLE 7C-1 (Cont)

Alternative	Terrestrial Resources b/	Aquatic Resources c/	Wetland Resources d/	Waterfowl Habitat e/	Water Quality	Endangered Species
Plan 4	12.1 percent increase in terrestrial resource value or 74,533 AAHU's. 38 acres of bottom-land hardwoods converted or a loss of 108 AAHU's. Hydrologic loss of 3,832 AAHU's on bottom-land hardwoods. Reforestation of 40,600 acres of bottom-land hardwoods or gain of 78,473 AAHU's.	5.2 percent increase in flood plain spawning habitat value or 10,466 HU's. 38 acres of bottom-land hardwoods converted or a loss of 142 HU's. Hydrologic loss of 49,151 HU's on various habitats. Reforestation of 40,600 acres of bottom-land hardwoods or gain of 59,759 HU's.	10.6 percent gain of wetland functional value or 23,295 FCU's. 38 acres of bottom-land hardwoods and 110.5 acres of farmed wetlands converted or a loss of 463 FCU's. Hydrologic loss of 39,469 FCU's. Reforestation of 40,600 acres of bottom-land hardwoods or gain of 63,227 FCU's.	45.2 percent loss of waterfowl foraging habitat value or 936,609 DUD's. Direct loss of 38 acres of bottom-land hardwoods or 2,166 DUD's. Hydrologic loss of 184,086 DUD's of waterfowl foraging habitat value; reforestation of 40,600 acres of bottom-land hardwoods or loss of 750,357 DUD's.	Construction of structural features will cause a short-term increase in turbidity; reforestation of 40,600 acres of agricultural land will improve water quality over time.	Same as Alternative 3 except reforestation of 40,600 acres will provide additional habitat.
Plan 5	17.4 percent increase in terrestrial habitat value or 107,674 AAHU's. 38 acres of bottom-land hardwoods converted or a loss of 108 AAHU's. Hydrologic loss of 2,896 AAHU's on bottom-land hardwoods. Reforestation of 62,500 acres of bottom-land hardwoods or a gain of 110,678 AAHU's.	18.7 percent increase in flood plain spawning habitat values or 37,428 HU's. 38 acres of bottom-land hardwoods converted or a loss of 142 HU's. Hydrologic loss of 29,919 HU's on various habitats. Reforestation of 62,500 acres of bottom-land hardwoods or gain of 67,489 HU's.	23.5 percent gain of wetland functional value or 51,520 FCU's. 38 acres of bottom-land hardwoods and 110.5 acres of farmed wetlands converted or a loss of 463 FCU's. Hydrologic loss of 18,579 FCU's. Reforestation of 62,500 acres of bottom-land hardwoods or gain of 70,562 FCU's.	42.1 percent loss of waterfowl foraging habitat value or 873,432 DUD's. Direct loss of 38 acres of bottom-land hardwoods or 2,166 DUD's; hydrologic loss of 80,438 DUD's of waterfowl foraging habitat; reforestation of 62,500 acres of bottom-land hardwoods or loss of 790,828 DUD's.	Construction of structural features will cause a short-term increase in turbidity; reforestation of 62,500 acres of agricultural land will improve water quality over time.	Same as Alternative 3, except reforestation of 62,500 acres will provide additional habitat.
Plan 6	21.9 percent increase in terrestrial habitat value or 134,987 AAHU's. 38 acres of bottom-land hardwoods converted or a loss of 108 AAHU's. Hydrologic gain of 1183 AAHU's on bottom-land hardwoods. Reforestation of 77,300 acres of bottom-land hardwoods or a gain of 133,912 AAHU's.	30.9 percent increase in flood plain spawning habitat value or 61,754 HU's. 38 acres of bottom-land hardwoods converted or a loss of 142 HU's. Hydrologic loss of 12,659 HU's on various habitat. Reforestation of 77,300 acres of bottom-land hardwoods or gain of 74,555 HU's.	47.9 percent gain of wetland functional value or 104,927 FCU's. 38 acres of bottom-land hardwoods and 110.5 acres of farmed wetlands converted or a loss of 463 FCU's. Hydrologic gain of 22,072 FCU's. Reforestation of 77,300 acres of bottom-land hardwoods or gain of 83,318 FCU's.	30.1 percent loss of waterfowl foraging habitat value or 634,017 DUD's. Direct loss of 38 acres of bottom-land hardwoods or 2,166 DUD's; hydrologic gain of 326,326 DUD's of waterfowl foraging habitat value; reforestation of 77,300 acres of bottom-land hardwoods or loss of 958,177 DUD's.	Construction of structural features will cause a short-term increase in turbidity; reforestation of 77,300 acres of agricultural land will improve water quality over time.	Same as Alternative 3, except reforestation of 77,300 acres will provide additional habitat.

TABLE 7C-1 (Cont)

Alternative	Terrestrial Resources b/	Aquatic Resources c/	Wetland Resources d/	Waterfowl Habitat e/	Water Quality	Endangered Species
Plan 7	29.4 percent increase in terrestrial resource value or 181,328 AAHU's. 38 acres of bottom-land hardwoods converted or a loss of 108 AAHU's. Hydrologic gain of 3,721 AAHU's on bottom-land hardwoods. Reforestation of 107,000 acres of bottom-land hardwoods or a gain of 177,715 AAHU's.	41.9 percent increase in flood plain spawning habitat value or 83,860 HU's. 38 acres of bottom-land hardwoods converted or a loss of 142 HU's; hydrologic gain of 2,802 HU on various habitats. Reforestation of 107,000 acres of bottom-land hardwoods or gain of 81,200 HU's.	56.0 percent gain in wetland functional value or 122,723 FCU's. 38 acres of bottom-land hardwoods and 110.5 acres of farmed wetlands converted or a loss of 463 FCU's. Hydrologic gain of 30,824 FCU's. Reforestation of 107,000 acres of bottom-land hardwoods or gain of 923,621 FCU's.	29.6 percent loss of waterfowl foraging habitat value or 612,924 DUD's. Direct loss of 38 acres of bottom-land hardwood or 2,166 DUD's. Hydrologic gain of 362,462 DUD's of waterfowl foraging habitat. Reforestation of 107,000 acres of bottom-land hardwoods or loss of 973,220 DUD's.	Construction of structural features will cause a short-term increase in turbidity, reforestation of 107,000 acres of agricultural land will improve water quality over time.	Same as Alternative 3, except reforestation of 107,000 acres will provide additional habitat.

NOTE: For detailed information on aquatic resources, waterfowl resources, terrestrial resources, wetlands resources, water quality, ground water, and endangered species, see Appendixes 9-15.

a/ Terrestrial, aquatic, wetland, and waterfowl impacts include losses from the completed and reformulated portions of the Yazoo Backwater area. Water quality, ground water, and endangered species apply only to the reformulated portion of the Yazoo Backwater project area.

b/ AAHU = average annual habitat units.

c/ HU = units.

d/ FCU = functional capacity units.

e/ DUD = duck-use-days. Although reforestation results in a loss of waterfowl foraging habitat by all plans, there are other important waterfowl habitat requirements that are met with reforestation (loafing, pair bonding, shelter, etc.) and that are notably absent in agricultural fields. According to the U.S. Fish and Wildlife Service, the overall benefit that results from reforestation far exceeds losses of foraging habitat.

c. Water resources. Many of the existing stream habitats have been altered and have poor water quality. Construction of the recommended plan will result in temporary adverse impacts (increased sedimentation/turbidity) on existing aquatic habitat in streams in the project area. Reforestation of 62,500 acres of agricultural land will improve water quality over time.

(1) The Yazoo River system is one of the few remaining large tributaries of the lower Mississippi River without manmade barriers to fish movement. However, previous channel modification has straightened and smoothed sides and bottoms; removed sediment-trapping snags, vegetation, and debris; provided auxiliary channels; and cutoff meander loops. The Yazoo and other rivers in the area are turbid and meandering with deep, swift channels and slack-water areas associated with sandbars and cutbanks.

(2) A diversity of flood plain features provides an array of fisheries spawning and rearing habitats. Approximately 72,316 acres of 2-year average seasonal flooded acres exist under current conditions. Agricultural and fallow land dominate flood plain habitat, accounting for 64 percent of the total areas. Other features include natural levees, scatters and brakes, oxbow lakes, point bar ridges and swales, bottom-land hardwoods, manmade water bodies, weirs, and tributaries.

d. Mineral resources. The mineral resources (sand, gravel, clay, etc.) or the extraction processing industries of these resources located within the Yazoo Backwater impacted area would receive no adverse impacts from implementation of the recommended flood control project.

e. Fish and wildlife resources.

(1) Terrestrial resources. Terrestrial wildlife habitats range from open, agricultural monocultures to diverse and productive bottom-land hardwoods. Agricultural fields and edges between bottom-land hardwoods and agricultural fields provide habitat for some species. However, 233,869 acres of bottom-land hardwoods provide the highest quality and most stable habitat. The U.S. Fish and Wildlife Service classifies bottom-land hardwood as Resource Category 2; i.e., habitat to be impacted is of high value for evaluation species and is relatively scarce or becoming scarce on a national basis or in the ecoregion section. Terrestrial wildlife species present in the project area and associated with bottom-land hardwoods include white-tailed deer, raccoon, cottontail and swamp rabbits, squirrels, field mice, mink, etc., and birds such as wood duck, wild turkey, owls, woodpeckers, various song birds, etc. Habitat Evaluation Procedures quantified bottom-land hardwood and cypress habitat for terrestrial species (Table 7C-1 and Appendix 12). With implementation of the recommended plan, terrestrial habitat would incur a net gain of 17.4 percent in average annual habitat units.

(2) Waterfowl resources. There are 9,138 acres of average seasonal habitat available currently. With implementation of the recommended plan, a 42.1 percent loss of waterfowl foraging habitat would occur.

(3) Fishery resources. There are 72,316 acres of 2-year average seasonal flooded acres available under existing conditions. With implementation of the recommended plan, flood plain spawning habitat would increase by 18.7 percent.

28. Sociocultural Elements. Implementation of the recommended plan will have the beneficial impact of converting approximately 62,500 acres of the project area to bottom-land hardwoods. However, some residents may view the loss of agricultural cropland as an adverse impact to the area.

29. Environmental Analysis. Environmental impacts of this project were analyzed using a habitat unit analysis for terrestrial and aquatic resources only. Waterfowl impacts were based on a duck-day analysis, and wetland analysis was based on qualitative functional acreage-based analysis. These impacts are presented in Table 7C-1 and Appendix 12.

SOCIAL PARAMETERS

Other Social Effects (OSE)

30. Community Cohesion. Community cohesion will be strengthened from construction of the recommended plan due to the alleviations/reductions of flood damages and threat of flooding. No adverse impacts on community cohesion are anticipated.

31. Community Growth. Community growth is usually interpreted in terms of an increasing population with corresponding increases in community services and a healthy area economy. Favorable impacts on community growth would be expected to occur during actual construction of the recommended plan and would be evident throughout the project life as additional income is generated by the expected higher crops yields and net returns. There would be some initial reduction in area income as lands are converted from crops to woodlands; however, this loss would be offset by gains in area recreational opportunities and returns to timber production. Favorable impacts during this period will generally be short term. The project is not expected to result in any significant long-term community growth.

32. Population Growth. Installation of the recommended plan is not expected to have any significant impact on study area population trends. During project construction, the population of the project area will increase slightly due to influx of construction workers. This influx of workers will be short term, however, and is not expected to have measurable impacts on the population growth, density, or migration patterns of the area in the postconstruction period.

33. Noise. Noise created by project construction will be a nuisance, with the project area absorbing the impact of these noises. However, since most of the construction in the project area is not adjacent to a populated area, adverse impacts from noise will be minimal.

34. Displacement of People. Installation of the recommended plan will not displace any families in the Yazoo Backwater (impacted) area.

35. Esthetic Values. The conversion of 62,500 acres of agricultural cropland in the project area to bottom-land hardwoods by the installation of the recommended plan will provide beneficial impacts to the esthetic values of these areas. Land disturbance during project construction will create unsightly conditions that will be remedied as construction is completed and vegetation recovers.

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

36. Installation of the recommended plan of improvement in the project area will result in the irretrievable and irreversible commitment of land resources for the entire project life. Lands required for project construction will be removed from existing use while potential alternative uses will be precluded. Implementation of project features will irreversibly and irretrievably commit the labor and materials associated with construction activities. Planning and technical expertise, as well as monetary resources, will be irretrievably committed to the Yazoo Backwater project.

SYSTEMS OF ACCOUNTS

37. Beneficial and adverse contributions identified in each of the four accounts are summarized in the following paragraphs and displayed in the Main Report and Table 7C-2 of this appendix.

a. NED. Beneficial contributions to the NED account consist of flood control benefits and employment benefits. Adverse contributions to the NED account include the value of resources for project construction and project operation and maintenance. Net national economic benefits are estimated at $3,543,000 annually for the recommended plan (Table 7C-2).

b. EQ. The recommended plan will decrease waterfowl foraging habitat through reduction of winter-foraging areas. Parameters receiving positive adverse impacts include esthetics, terrestrial resources, aquatic resources, wetlands, and water quality. Approximately 62,500 acres of agricultural cropland in the project area would be converted to bottom-land hardwoods with installation of the recommended plan. Insignificant temporary adverse impacts on water quality will be incurred during project construction. Beneficial and adverse impacts for the EQ account are presented in Table 7C-2.

c. RED. Parameters for income, employment, "desirable" regional growth, and business and industrial activity are expected to benefit from project installation. No impacts were determined to be significantly adverse to regional development. Beneficial impacts to RED would result from increased income and employment associated with construction of the recommended plan. The estimated net annual benefits accruing from installation of the recommended plan are $3,543,000 (Table 7C-2).

d. OSE. Beneficial contributions to the OSE account are reflected in community cohesion and community growth parameters (Table 7C-2). Community cohesion is expected to be strengthened by the reduction of flood damages and the reduced threat of flooding in the four built-up areas and the project area.

TABLE 7C-2
PROJECT ECONOMIC, ENVIRONMENTAL, SOCIAL, AND OTHER IMPACTS DISPLAY
BY SYSTEMS OF ACCOUNTS (NED, EQ, RED, OSE)
RECOMMENDED PLAN (ALTERNATIVE 5)
YAZOO BACKWATER AREA, MISSISSIPPI
(6-5/8 Percent Discount Rate)

Account/Parameter	Location of Impact	Type Impacts		Total (Net National Impact)
		Beneficial	Adverse	
1. NATIONAL ECONOMIC DEVELOPMENT (NED)				
a. Annual Benefits ($000):				
Flood Control 6/9/12/ 13/	Project Area	17,918	0	17,918
Employment 3/9/12/	Study Area	506	0	506
Total NED Benefits		18,424		18,424
b. Annual Costs ($000):				
Project Construction 3/6/9/12/				
Federal	Rest of Nation	0	14,727	14,727
Operation Rehabilitation 3/5/9/12/				
Federal	Rest of Nation	0	154	154
Total NED Costs			14,881	14,881
c. Net NED Benefits/Costs ($000):		3,543	0	3,543 1/
d. Benefit-Cost Ratio		1.24	--	1.24
2. ENVIRONMENTAL QUALITY (EQ)				
a. Environmental Quality Enhanced/Preserved/ Protected:				
* Natural resources 3/9/12/	Project Area	Conversion of 62,500 acres of agricultural cropland in the Yazoo Backwater area hardwoods.	None.	
b. Environmental Quality Degraded:				
(1)* Air 3/6/9/12/13/	Project Area	--	Project construction will add to residues in atmosphere from open-air burning, dust, and from operation of internal combustion engines.	Short-term degradation of air quality in the area.
	Study Area	--	Insignificant	No Significant impact.
(2)* Water/water quality 3/6/9/12/	Project Area/ Study Area (Flood Plain)	Long-term increase in water quality by conversion of agriculture to forest will reduce direct and indirect nonpoint source pollution.	Adverse impact on water quality and aquatic habitat (ecosystem) in streams from project construction. Increased turbidity during construction will be temporary.	Positive impact on water quality and aquatic habitat in area streams.

TABLE 7C-2 (Cont)

Account/Parameter	Location of Impact	Type Impacts		Total (Net National Impact)
		Beneficial	Adverse	
c. Environmental Quality Destroyed:				
(1)* Natural resources 3/9/12/	Project Area	--		
(2)* Manmade resources 3/9/12/	Project Area			
3. REGIONAL ECONOMIC DEVELOPMENT (RED)				
a. Income:				
(1) Summary, annual benefits ($000)				
Flood control 6/9/13/	Project Area	17,918	0	17,918
Employment 6/9/13/	Study Area	506	0	506
Regional Economic Development	Study Area	0	0	0
Indirect personal income increases with project construction ($000) 6/9/10/13/				
Total Benefits		18,424		18,424
(2) Excess Benefits Over Cost ($000)		3,543		3,543
(3) Benefit-Cost Ratio		1.24		1.24
b. Employment/Labor Force: *				
(1) Project construction 3/9/11/12/	Project Area	The total number of jobs created over the 3-year construction period is estimated at 1,000. Classification by skill level consists of 48 percent skilled, 24 percent semiskilled, 8 percent unskilled, 20 percent supervisory and administrative. Temporary impact.		Negligible.
	Study Area	Negligible, temporary.	--	Negligible.
(2) Project operation and maintenance 6/9/12/	Project Area	Negligible.	--	Negligible.
(3) Indirectly induced jobs 3/8/12/	Study Area	Negligible.	--	Negligible.
(4) Other regional employment impacts 3/6/8/13/		Insignificant.	--	Insignificant.

TABLE 7C-2 (Cont)

Account/Parameter	Location of Impact	Type Impacts		Total (Net National Impact)
		Beneficial	Adverse	
c. Business and Industrial Activity: 5/8/12/	Project Area	Temporary increase in activity.	--	Activity will increase temporarily.
	Study Area	Temporary stimulation of existing business and industrial activity by income increases, employment opportunities, multiplier, impacts, etc.	--	Temporary stimulation of existing business and industrial activity. Net beneficial effect.
d. Tax Revenues: * 5/7/12/	Study Area	Minor decrease in tax revenues expected, resulting from conversion of cropland to woodland.	--	Minor decrease in tax revenues expected.
e. Property Values ($000): 6/9/11/12/	Project Area	Protected area land value will increase, particularly lands subject to being converted to nonagricultural use (residential, commercial, etc.).	--	Increase in value of flood-free lands.
f. Desirable Regional Growth: 5/9/12/	Project Area	Consistent with local and regional development plans	--	Compatible with local and regional planning.
	Study Area	--	--	--
	Rest of Nation	Insignificant.	--	Insignificant.
g. Local Government Finance: 5/9/12/	Study Area	--	--	--
h. Public Facilities: * 5/8/12/	Study Area	--	Negative impact.	Negative impact.
i. Public Services: * 5/8/12/	Study Area	--	Negative impact.	Negative impact.
j. Displacement of Farms/Ownerships: * 3/9/12/	Project Area	--	Potential for impacting farm property ownerships by acquisition requirements for project construction. Impacts on ownerships affected not expected to adversely impact existing farming operations of affected ownerships. 5/8/13/	Negligible.
k. Tax Rates: 6/8/12/	Project Area	--		
	Study Area	--		

TABLE 7C-2 (Cont)

Account/Parameter	Location of Impact	Type Impacts		Total (Net National Impact)
		Beneficial	Adverse	
4. OTHER SOCIAL EFFECTS (OSE) a. Community Cohesion: * 5/8/12/	Project Area	Strengthened due to reduced flood threat and reduced flood damages.	--	Should improve standard of living.
	Study Area	Strengthened due to reduced flood threat and reduced flood damages.	--	Should improve standard of living.
b. (Desirable) Community Growth: * 5/8/12/	Study Area	Temporary favorable impacts expected with project construction.	--	Positive impact.
c. Population Growth: 3/9/12/	Study Area	Insignificant.	--	Insignificant.
d. Noise: * 6/9/12/	Project Area	--	Increased noise levels during project construction. Negligible impact, most of construction not adjacent to populated area.	Increase in noise levels expected. Impact negligible.
e. Displacement of People: *	Project Area	--	No families would be displaced.	No displacement of families.
f. Esthetic Values: * 3/6/9/12/	Project Area	--		
	Study Area	--	Negligible.	Negligible.
g. Community Growth: 5/8/12/	Study Area	Project construction not expected to result in any real population increase. Some minor temporary increase during construction activity only.	--	Insignificant.

NOTE: Costs shown reflect October 1999 levels.
1/ Excludes redevelopment benefits.
2/ Excludes redevelopment benefits.

Timing:
3/ Impact is expected to occur prior to or during implementation of the plan.
4/ Impact is expected with 15 years following plan implementation.
5/ Impact is expected in a longer timeframe 15 or more years following implementation).
6/ Impact is expected over project life.

Uncertainty:
7/ The uncertainty associated with the impact is 50 percent or more.
8/ The uncertainty is between 10 and 50 percent.
9/ The uncertainty is less than 10 percent.

TABLE 7C-2 (Cont)

Exclusivity:
10/ Overlapping entry; fully monetized in NED account.
11/ Overlapping entry; not fully monetized in NED account.

Actuality:
12/ Impact will occur with implementation.
13/ Impact will occur when specific additional actions are carried out during implementation.
14/ Impact will occur because necessary additional actions are lacking.

CONCLUSIONS

38. Identification and evaluation of impacts resulting directly from or induced by installation of the recommended plan yielded the following conclusions.

a. The recommended plan (Alternative Plan 5) would satisfy local needs for provision of flood protection for the four built-up urban areas and adjacent agricultural sectors of the project area.

b. The plan would provide beneficial contributions to NED. In addition, the plan would provide beneficial contributions to RED, OSE, and EQ.

c. The plan would create beneficial impacts on environmental quality due to the increase, alteration, or conversion of cropland to woodlands. Beneficial impacts will occur from construction of the recommended plan to terrestrial, wetland, and aquatic resources (private lands). Beneficial impacts will accrue to fish and wildlife through acquisition of easements from willing sellers for conversion of 62,500 acres of agricultural cropland to bottom-land hardwoods in the project area.

d. The recommended plan would be consistent with local and regional land use and development plans.

ATTACHMENT 7D

BASE AGRICULTURAL SURVEY DATA
YAZOO BACKWATER AREA, MISSISSIPPI

CONFIDENTIAL

OMB Approval No. 0710-0001
Expiration Date: 30 November 1995

BASE AGRICULTURAL SURVEY DATA
YAZOO BACKWATER AREA, MISSISSIPPI

NAME _____ DATE _____

TITLE _____ REACH(S) _____

TELEPHONE _____ COUNTY _____

LOCATION _____

LAND USE

1. Determine strata point (point where agricultural practices/management differs because of threat of flooding or due to soil type). _____

_____

_____

_____

2. Crop Distribution/Yield:

	Existing Conditions			
	Lower Area (Strata) of Reach		Upper Area (Strata) of Reach	
Crop	Crop Distribution (%)	Flood-Free Yield	Crop Distribution (%)	Flood-Free Yield
Cotton				
Soybeans				
Soybeans (DC)				
Rice				
Wheat				
Wheat (DC)				
Grain Sorghum (Milo)				
Corn				

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Nov 93

(Proponent CELMK-PD-E)

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LAND USE (Cont)

Crop	With-Project Conditions: Lower Area (Strata) of Reach — Crop Distribution (%)	Lower Area (Strata) of Reach — Flood-Free Yield	Upper Area (Strata) of Reach — Crop Distribution (%)	Upper Area (Strata) of Reach — Flood-Free Yield
Cotton				
Soybeans				
Soybeans (DC)				
Rice				
Wheat				
Wheat (DC)				
Grain Sorghum (Milo)				
Corn				

3. Catfish Ponds:

Are catfish ponds located in reach? (Yes/No)

Have damages occurred from flooding? (Yes/No)

Type of Damages:

a. Overtopping of levees: (Yes/No) When _____ Acres Impacted _____

(1) Losses/damages:

	($)	
Restocking		
Market Fish		
Levees		
Feed		
Equipment		
Miscellaneous		
Total Damages		

Catfish Ponds: (Cont)

b. Nonovertopping Damages: (Yes/No) When _____ Acres Impacted _____

(1) Losses/damages:

	($)	
Levees	_____	_____
Equipment	_____	_____
Miscellaneous	_____	_____
Restocking	_____	_____
Market Fish	_____	_____
Feed	_____	_____
Total Damages	_____	_____

(2) Height and duration of water against levees?

Height _____

Duration _____

4. Number of cleared acres in Conservation Reserve Program and their location on quad sheets.

Comments: _____

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OTHER AGRICULTURAL PROPERTY DAMAGE FROM FLOODING

Item	Type	Quantity	Cost/Unit	Depth of Flood	Estimated Damage	
					($)	(%)
Farm Roads						
Drainage Ditches						
Fences						
Land Leveling						
Land Damage						
Equipment and Damage/Depreciation						
Farm Buildings						
Stored Feeds						
Other						

YAZOO BACKWATER AREA, MISSISSIPPI
PRIVACY ACT STATEMENT

A. AUTHORITY. 10 U.S.C. 3012.

B. PRINCIPAL PURPOSES. Currently, detailed studies have been initiated for a reformulation study of the Yazoo Backwater Area, Mississippi, project. The U.S. Army Corps of Engineers is using this survey to obtain information to aid in determining the current economic feasibility of the above project in accordance with the Water Resources Council's Principles and Guidelines.

C. ROUTINE USES. Data will be collected and tabulated, but will not be filed or published by names or persons surveyed. Individual responses will be temporarily retained in our files as backup data. Only the tabulated totals of the types of responses will be published in a report which will be circulated to other Federal and state water and land management agencies for planning purposes. Individual names, individual responses, or information from individual responses will not be released.

D. DISCLOSURE MANDATORY OR VOLUNTARY; THE EFFECT OF NOT PROVIDING THE INFORMATION. Although your participation in the survey is entirely voluntary, your answers to survey questions will enable us to accomplish the analyses. Your response will be appreciated and will be an important aid in the planning effort for this project.

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